SUGGESTIONS

X/33

REGARDING

FOREST ADMINISTRATION

IN

AJMERE AND MERWARA

BY

D. BRANDIS,
INSPECTOR GENERAL OF FORESTS TO THE GOVERNMENT OF INDIA;

WITH A MAP

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NOTE.—The authorities of systematic names have been omitted; the names are those adopted in recent standard Botanical works.

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DATED SIMLA, THE 1ST NOVEMBER 1879.

CHAPTER I.

INTRODUCTION.

Effects of settlement made in 1850.

THE waste lands and hills in the Government villages of Ajmere and Merwara were originally the absolute property of the State, and the people had no vested rights in them. Colonel Dixon, who for many years governed these districts in an admirable manner, and whose name is still remembered with feelings of sincere gratitude by the inhabitants, for the first time demarcated village from village by regular boundaries, and at the settlement in 1850 included the waste in the Shamilat or common land of the villages; but at the same time the villagers on their part bound themselves to plant trees and preserve the jungle to a reasonable extent. This engagement they have never attempted to keep.* The consequence was that these lands gradually became denuded; that in dry seasons they failed to afford sufficient pasture for the village cattle; that wood was getting scarce; that the water-supply in wells and streams became uncertain; that the smaller tanks silted up at an alarming rate, and that in many cases the bunds were breached by sudden floods rushing down the bare hill sides. Many of the numerous tanks constructed by Colonel Dixon had been rendered either useless or their usefulness had been greatly impaired.

Measures proposed in 1871.

2. I paid a rapid visit to these districts in December 1869, and submitted my conclusions to Government in a report dated January 1871, an extract from which will be found appended to the Forest Conference Report of 1875. In accordance with the suggestions then made, it was decided to acquire certain areas on the hills of these districts, and to improve them by protection and planting. The period of the settlement made in 1850 having expired, a new settlement was commenced in 1870, and it was decided to make an attempt at the new settlement to secure the control of certain selected tracts of hill and waste.

Legislation.

3. As, however, it was found impossible to obtain the consent of the people to the arrangements proposed to them by the Settlement Officer, it was decided to have recourse to legislation, and accordingly in December 1874 the Ajmere Forest Regulation was passed, which empowered Government to take up any tracts of waste and hilly land for the purpose of forming State forests, certain rights in such lands being secured to the villagers. The chief rights thus secured are the right to cut grass and the right to cut such wood as is reasonably necessary for their household requirements and agricultural implements. It was further stipulated that two-thirds of the net profits from the management of these forests should be distributed among those persons who, previous to the taking up of the land, were interested therein. The rights secured to the

* See replies to Famine Commission question No. 97, by James White, C.S., Assistant Commissioner of Ajmere, February 1879.

villagers have been exercised by them to the full extent permitted, but the revenue of these reserves has as yet been insufficient to cover the expenses, and therefore no profits have yet been distributed. But the supply of grass and wood available for the right-holders has increased to such an extent that the people have already profited largely by the protection of these areas, and the benefits to them of this measure are now beginning to be recognized by the more intelligent among them.

Appointment of Forest Officers.

4. Previous to the passing of this Regulation, two Forest Officers (Mr. E. McA. Moir, Assistant Conservator, and Anwar Khan, Sub-Assistant Conservator) were posted to Ajmere and placed under the orders of the Commissioner. This was in March 1872, and operations were commenced at once by the establishment of plantations on certain lands which were at the disposal of Government, and by the protection, as a preliminary measure, of some of the tracts which it had been determined to take up as State forests.

In accordance with the provisions of the Forest Regulation, a number of tracts, aggregating about 64,000 acres, were gradually taken up and declared State forests; and in June 1875 a set of Forest Bye-laws, drawn up under the Regulation, was published for general information. A copy of the Regulation and of the Bye-laws are appended to the present report. Further details regarding the history of forest conservancy in these districts will be found in certain papers by Mr. Saunders, Commissioner, Major Repton, Deputy Commissioner of Ajmere, and by Mr. E. McA. Moir, Assistant Conservator of Forests, which were read at the Forest Conference of 1875, and are printed on pages 39 to 48 of the proceedings of that Conference. It should here be stated that the boundaries of the demarcated State forests have been surveyed by a party of the Topographical Survey Department, and entered by hand on the maps of these districts published on the scale of 1 inch to 1 mile. These State forests are also termed Reserves or Reserved Forests, and for convenience sake these terms will be used in this report.

Mr McA. Moir's services.

5. Subsequently, it was considered no longer necessary to maintain a superior Forest Officer in Ajmere, and Mr. E. McA. Moir was, in September 1876, transferred to the Punjab. It is here the place to state that the satisfactory condition of the State forests, as found on careful examination in detail of these areas during this late tour of inspection, is chiefly due to the energy and intelligence with which Mr. McA. Moir devoted himself to his task, and to the effective help which he obtained from the civil officers. During the four years of his holding charge of these forests, Mr. McA. Moir has laid the foundation of good forest management in Ajmere.

Mr. McA. Moir's transfer to the Punjab was made on the understanding that, if required, he might from time to time be deputed to Ajmere to inspect the reserves and to give advice regarding the work to be done. Accordingly, in November last, he was directed by the Punjab Government to proceed to Ajmere in order to accompany the writer of the present report on his tour of inspection through the reserves of that district. With the permission of the Government of the North-Western Provinces, Captain Bailey, Conservator of the School Forests in those Provinces, joined in the inspection, and the present report has been prepared with the assistance of Captain Bailey and Mr. McA. Moir.

Account of tour.

6. I reached Ajmere on Thursday, the 5th December, inspected the Taragarh Reserve on the 6th and 11th (on the 6th in company with Mr. White, the Assistant Commissioner), the Nagpahar and the country near it on the 7th and 8th, the Mohwa Bir on the 9th, and the Srinagar, Bir, and Danta forests on the 10th. On the occasion of this and my subsequent visit to Ajmere at the end of the month, I had the privilege of discussing the probable effects of forest conservancy upon the water-supply in wells and tanks with Mr. W. Culcheth, Executive Engineer, Irrigation Division. These discussions and the data most obligingly furnished me by Mr. Culcheth, helped me materially to a better understanding of this difficult and important question. On the 11th I proceeded to Beawar in the evening, and devoted the time from the 12th to the 30th to the forests in Merwara, inspecting Dilwara Bir on the 12th, the Chang forest on the 13th, Borwar and Kotra on the 14th, Biliawas on the 16th, the Todgarh tract on the 17th, 18th, 19th, and 20th, and the proposed new reserve near Dewair on the 21st and 23rd.

On the 24th I ascended the Sanr Mata hill and visited the reserved forests on that range and near the town of Deogarh, both the property of the Thakur of Deogarh in Meywar; on the 25th, 26th, and 27th, the country between Barar and Kukra hill was examined with a view to the selection of new reserves in this portion of Merwara, where no forests have as yet been demarcated. In Merwara I had the privilege of being accompanied on the 17th, 26th, and 27th by Captain Robertson, the Assistant Commissioner in charge of the district. . On the 30th I returned to Ajmere, which place I left on the 1st January 1879 for Allahabad and Calcutta.

CHAPTER II.

GENERAL ACCOUNT OF THE RESERVES.

Areas.

7. The total area of the reserves at present demarcated is 64,428 acres, which is distributed as follows:—

	Acres.
In Ajmere—	
Mohwa Bir and Madar Hill	2,812
Nagpahar	2,660
Taragarh	1,016
Srinagar and Bir	3,575
Rajausi	1,260
TOTAL	11,323
In Merwara—	
Chang	2,311
Hatun and Sheopura	1,920
Todgarh and Barakhan	40,048
Dilwara and Chang Birs	235
Borwar and Kotra	3,923
Anspahar	1,466
Biliawas	3,172
TOTAL	53,105
GRAND TOTAL	64,428

This is the area according to the settlement records, supplemented by surveys made by the forest officers.

Rights of the people as defined by the Forest Regulation.

8. These forests have been declared State forests under the Ajmere Forest Regulation of 1874, and in accordance with the provisions of that Regulation, the villagers have the right to cut grass and to cut such wood as is reasonably necessary for their household requirements and agricultural implements; also, to use all ways of a defined and permanent character which were in use by them at the time the reserves were declared Government forests, and which are still adapted for use.

Rights by whom held.

9. The Regulation defines the term "villagers" to include the members of the proprietary body of any village, and gives power to the Commissioner, subject to the control of the Chief Commissioner, to declare any other persons or class of persons entitled to the status of villagers. The Regulation does not expressly state that these rights are vested in the inhabitants of certain villages only, but it is understood that under the settlement these rights can only be exercised by the inhabitants of those villages, portions of the areas of which were taken up to form the forest, and that the rights of the inhabitants of each village extend only to the area taken from their own villages. To some extent the pasture in adjoining villages is interchangeable, that is, the cattle of some villages graze on the waste lands of neighbouring villages, and *vice versâ*. Traders and others who hold no land and pay no land revenue are not supposed to be entitled to exercise these rights unless they are specially authorized to exercise them. Like forest rights generally, these rights are vested in the holders of the cultivated land outside the forest.

Exercise of rights how controlled.

10. The rights here mentioned are exercised subject to the control of the Forest Officer, his orders being open to appeal to the Commissioner. As regards the cutting of grass, the Forest Officer may determine the seasons at which it may be cut and the mode of cutting it, and he may prohibit the cutting of grass in

any part of the land where such cutting would interfere with the growth of the young seedlings. As regards the cutting of wood, the Forest Officer may determine the season when and the place where it may be cut. It is understood that the term "wood" does not include bamboos, but that under the provisions of the Regulation wood may be collected for fuel. As regards the rights of way, the Forest Officer may stop any path through the forest and assign another path instead of it, provided that the new path set out by him be a reasonable substitute for the way so stopped.

Pasture.

11. The grazing of cattle is prohibited, but the Regulation provides that no fine shall be levied in respect of any trespass of cattle until the Forest Officer has sufficiently fenced the portion of the forest in which grazing is prohibited, or, with the Commissioner's sanction, has demarcated it with conspicuous marks. Finally, the Regulation provides that a certain proportion of the net profits which may from time to time result from the working of the forest, after deducting all expenses of management, shall be paid to the persons who were interested in the land previous to its being included in the State forests.

Fences constructed.

12. The following statement shows the length of fencing completed in the different tracts about the end of 1878 in accordance with the provisions of clause 8 of the Regulation:—

Name of reserve.	Length in feet of fencing completed.	Total feet.
Ajmere District.		
Mohwa and Madar hills	58,665	
Nagpahar	32,986	
Taragarh	1,667	
Srinagar and Bir	53,961	
Rajausi	21,362	
		168,641
Merwara District.		
Chang	28,788	
Hatun and Sheopura	44,348	
Todgarh and Barakhan	30,716	
Dilwara and Chang Birs	37,758	
Borwar and Kotra	11,134	
Auspahar	2,679	
Bilhawas	...	155,423
GRAND TOTAL	...	324,064

It will be seen that the total length of these fences aggregates 324,064 feet*. They have been made in the vicinity of villages and in other exposed places.

Fences in Ajmere District.

13. Several tracts in Ajmere, *viz.*, Mohwa Bir, Madar, and Rajausi, are completely surrounded by fences. In this district they consist partly of stone walls and partly of hedges of "thor" (*Euphorbia Nivulia*, Ham.). These hedges have succeeded well in Mohwa Bir, on Madar Hill, and also in Srinagar and Rajausi. The "thor" was planted in March and April, and some of the hedges are now four years old, are 3 to 4 feet high, and afford complete protection. A hedge planted by Colonel Dixon not less than twenty years ago along the Lohagal road is dense, 10 feet high, and in good condition. On very stony ground "thor" hedges do not succeed well. On suitable soil, and if carefully planted, as far as our experience goes, they require repairs during the first three or four years only; but once thoroughly established they last for a very long time, requiring no further outlay.

Thor fences.

14. These fences are made by planting cuttings about 3 feet long in two or three parallel lines. The cuttings are placed in small holes about 6 inches deep and about 1 foot apart within the lines, which are distant from one another about 2 feet. The cuttings, which must be fresh, should be planted

* On the 31st March 1879, the total length of fencing was 373·825 feet, while the boundaries of the state forests had an aggregate length of 968·860 feet.

in March and April. The first cost of planting such a fence in the Ajmere District has been found to be about one rupee per 100 running feet for a double line, the amount varying according to the locality. Mr. McA. Moir has made numerous experiments at all seasons of the year to ascertain the best time and method of establishing "thor" fences, and has proved that when planted in the rains and in the cold weather they do not succeed at all. The only drawback to these fences is that they take a few years before they grow up sufficiently to afford protection, whereas a stone wall affords protection at once.

Fences in Merwara District: stone walls.

15. In Merwára "thor" fences have succeeded in parts of the Chang tract, but not elsewhere. Here from the beginning stone walls were resorted to, and these now form the chief fencing. In the western part of Merwara, which includes the large Todgarh tract, "thor" is not common, and the ground is very stony; but on the drier hills along the eastern border of the district, "thor" is as common as in Ajmere, and there seems no reason why fences of it should not succeed.

Some walls are built about 18 inches thick and 3 feet high. Where suitable stone is abundant on the ground, the cost has been as low as two rupees eight annas per 100 running feet; but under less favourable circumstances it has risen as high as four or five rupees per 100 feet. It frequently happens that the fence crosses the bed of a stream where it cannot of course be maintained. Here the custom has hitherto been to close the gaps by temporary fences of thorns. During the last year or two before our visit, this had not been done regularly everywhere, and care should be taken to insist on the closing of these gaps after the rains.

Boundary marks.

16. Those portions of the boundary lines which are not fenced have been throughout efficiently demarcated by masonry pillars or by stone slabs at suitable distances. The serial numbers on the boundary marks are either cut into the slabs or painted on them. The boundary marks in some of the Ajmere reserves are particularly suitable, the numbers being cut deep into the stone slabs. Some additional fencing may perhaps be needed for the Borwar and Kotra tracts, otherwise the work of fencing and demarcation, as required by the Regulation, may be said to have been nearly completed in a very effective manner.

Grazing within the reserves

17. No grazing at all is permitted within the reserves except in the following cases:—

In Srinagar an area of about 1,000 acres is opened annually, from October to June, to the cows, buffaloes, and bullocks of the Srinagar village; and a few small hamlets have been left inside the Biliawas and Todgarh reserves, the inhabitants of which hamlets are allowed pasture for a fixed number of cattle within those reserves. There are seven hamlets in Todgarh and one in Biliawas. During the hot weather of 1878, when grass was very scarce in the district owing to the deficient rainfall of 1877, the Todgarh, Biliawas, Hatun, Anspahar, Borwar, and Kotra reserves were opened for grazing during the months of April, May, and June, and the lives of many cattle were saved thereby. Grazing dues were levied in some cases. The Rajausi tract was not closed against the grazing of buffaloes, cows, and bullocks until the rains of 1878.

Forest offences.

18. The following statement shows the number of prosecutions and convictions on account of forest offences in the demarcated reserves:—

Year.	Prosecutions.		Convictions.	
	Cases.	Persons.	Cases.	Persons.
1875-76	18	65	16	45
1876-77	20	50	18	45
1877-78	132	468	124	353
1878-79	153	438	131	316
Total	323	1,021	289	759

Doubtless many offences are not discovered, and during my inspection of the reserves I came on several places where cattle had been pasturing in the forest

without permission; but on the whole, the protection of the reserves has been efficient. The total protective establishment consists of 5 Foresters and 32 Forest Guards. Thus, the average area of each forest guard's beat is about 2,000 acres: but, as a matter of fact, the beats are necessarily unequal, and while in the vicinity of the more thickly inhabited country near Ajmere the average area of a beat is less than 1,000 acres, their extent exceeds 5,000 acres in the wilder parts of Merwara.

Fire protection.

19. The principal instances in which fires have occurred in these reserves since they were taken up and demarcated have been the following:—

1st.—A large fire in the northern end of the Todgarh tract and several other smaller fires in the same tract.

2nd.—A fire in the Hatun tract.

3rd.—A fire in that part of the Taragarh forest in Ajmere, called Imli Kund, which was caused by the carelessness of coolies digging pits.

The above-mentioned fires all occurred during 1874. Since 1874 no important fires have occurred, and the whole of the reserves escaped burning during 1878.* On the whole, therefore, fire protection has been effectual. In Todgarh and Biliawas, where fires have been of most frequent occurrence, protection has been effected by burning a line round the outer boundaries, and by clearing the grass along all paths which traverse these tracts. In Ajmere the risk from fire is not very great, because the growth of grass is not heavy, and it is cut regularly by the people living in the vicinity of the reserves. Most of the Ajmere reserves also adjoin cultivated lands, and where they adjoin village waste or grazing grounds, these are not generally burnt, because there is no grass on them, and so their vicinity is no source of danger. Nevertheless it should be borne in mind that fires may occur in the Ajmere reserves by accident, and that precautions should not be neglected. In Chapter IV of this report the closing of certain blocks in these reserves against the cutting of grass has been recommended, and in such places the risk of fire will be considerable, and special precautions must be taken. In the Merwara reserves comparatively little grass is cut; it is much heavier there, as a rule, than in Ajmere, and as protection continues the quantity of dry wood on the ground must increase, and the damage done by any fire that may occur will be greater. Moreover, several of the reserves in Merwara adjoin waste lands in Meywar and Marwar, which are burnt almost every year. Here, therefore, it will be necessary to adopt in all reserves a regular system of fire conservancy, and this can best be done by burning lines round them and by burning intermediate lines following some of the main ridges and spurs. As the paths generally follow valleys and ravines, it will not be found easy to burn the grass along them.

It should be remembered that for some time to come the risk of fire in the reserves will be much greater than it has hitherto been, and that it will continue so until the forest growth has closed up sufficiently overhead to check the growth of grass. During the next five or ten years, therefore, the utmost efforts will be necessary to ensure the protection of the reserves from fire, and this must be regarded as the most important task to be accomplished at present in the management of these forests.

Improvement of the forests by cultivation.

20. It will be seen from Chapter IV of this report that considerable success has been attained in planting and sowing. In some cases the outlay on this account may have been high as compared with the results attained, but even in these cases the time and money expended upon these experiments have been fully repaid by the experience gained. The general character of the reserves has improved considerably; but it must be borne in mind that protection cannot accomplish everything, and that where seed-bearing trees are wanting, no great increase of young forest growth can be expected. Wind and birds, it is true, do much towards carrying seed to great distances, and in this manner the spread of certain trees, such as Nim, over the reserve may be explained. But the action of wind and birds is limited, and it is

* Two fires occurred in the hot season of 1879, one in Todgarh tract, destroying 27 acres; another in Nagpahar, which extended over 177 acres.

necessary to accelerate the process of the regeneration of these forests by increasing artificially the number of seed-bearing trees. Looking at the question from this point of view, the money expended in raising small plots of Siris, Kikar, and Sissoo in the valleys of the Taragarh reserve and elsewhere, must not be measured by the value of the trees raised in these localities but by the prospect of their seed being carried over the adjoining slopes of the hill. What has been done to raise trees in the reserves by sowing and planting has been a step in the right direction, and has been most creditable to the officers who have had charge of this work. Protection alone is at best very slow in its operation, and it is fortunate that the experience gained in sowing and planting will now make it possible to submit definite proposals for accelerating the process of improving these reserves.

Planting.

21. The cultural operations hitherto undertaken have been chiefly of two classes, *viz.*, planting and sowing. Nurseries have been established and are maintained in suitable localities. The chief expense of these nurseries has been for establishments. The present cost of the gardeners entertained for this work is reported to be about Rs. 19 per mensem in Ajmere, and Rs. 28 per mensem in Merwara. For the care and watering of the trees planted out in the different reserves, a number of bhisties are employed—14 in Ajmere, costing Rs. 84 per mensem, and 6 in Merwára, costing Rs. 36 per mensem. These men water the plants during the hot weather for two or three years, and do what is necessary to protect them against frost by grass covers. Some of these men are entertained for a portion of the year only This organization seems the most economical possible, and should be continued.

Selection of trees to be planted.

22. The chief trees hitherto planted have been Mango, Jaman, Siris, Doon Siris (*Albizzia procera*), Babool, Khair (*Acacia Catechu*), Jinja (*Bauhinia racemosa*), *Butea frondosa*, *Pongamia glabra*, Nim, and Sissoo. In addition to these I would recommend that special attention be paid to the propagation of trees with light seed or with fruit that is eaten by birds and game, so as to ensure their spread from self-sown seed, and of these I would mention specially *Ailanthus excelsa*, a rapid grower, which thrives singularly well on sandy soil, and the Indian Elm (*Ulmus integrifolia*), which is a common tree in Merwara, and also has light seed, and which should be planted largely. Ber (*Zizyphus vulgaris*) coppices very freely. Khirni (*Mimusops indica*) should be tried as an experiment; it is an evergreen shady tree which grows at Bassi in Meywar and in the Punjab. The common Sanatta (*Dodonæa viscosa*), a shrub which is indigenous in the Punjab and Sind, and is also found in the drier regions of Central India and the Deccan, should be tried on the hills of Merwara. It is a hardy, evergreen shrub, and if it succeeds, the winged capsules will ensure its spread.

As an experiment, I would also recommend that two kinds of bamboo be planted on as large a scale as circumstances may permit. These kinds are the common small Indian bamboo (*Dendrocalamus strictus*), which is indigenous on all the higher hills of Ajmere and Merwára, and which should be planted on dry ground, and the Khattang or thorny bamboo (*Bambusa arundinacea*), which should be planted in moist localities.

Indigenous trees in the arid and dry regions of India

23. In addition to these the following trees, which are natives of the dry and arid regions of India, should be cultivated as an experiment :—

(1) Kau (*Olea ferruginea*), a native of the outer hills in the North-Western Himalaya, of the salt range, the Trans-Indus District, and Sind. Not indigenous in Rajputana.

(2) Rohira (*Tecoma undulata*), a small tree, with handsome orange flowers and hard useful wood, which is found scattered on the hills of Merwara.

(3) Phalai (*Acacia modesta*), a tree with a very limited range, extending in the Northern Punjab from the Sutlej to the Indus, and found on the Salt Range.

(4) Farash (*Tamarix articulata*), which should be grown on saline soil where nothing else will grow, and which may be propagated both from cuttings and seed.

(5) Aritha (*Sapindus emarginatus*).

Treatment of plants in nurseries.

24. It has been found essential in all transplanting operations to treat the plants carefully in the nursery, and to bed them out at least once, and if

possible several times, before planting out. Strong plants with the tap roots cut back several times are much more likely to succeed than plants taken directly from the seed beds. Nothing can be said regarding the age at which they should be planted out; but they should not be less than 2 feet high.

Siendra plantation

25. As an instance of the rate of growth which can be attained with close planting and in a moist soil, a small plantation, eight years old, of Babul, Nim, and Siris, made by the Public Works Department at the inspection bungalow of Siendra in Merwara, may be mentioned. The trees were measured at the time of my visit on the 13th December 1878, and the following was the result :—

Nim.	Nim.	Nim.	Siris.	Babul.	Ber.	REMARKS.
9″	10″	11″	21″	25″	17″	Total number of trees 70.
12″	10″	12″	16″	15″	...	
11″	8″	5″	...	18″	...	
17″	11″	7″	...	19″	...	
9″	13″	12″	...	...	...	Average height of trees 30 to 40 feet.
9″	8″	9″	...	...	...	
10″	11″	9″	...	...	...	
7″	9″	8″	..	...	...	Average height to first branch 10 to 15 feet.
10″	11″	13″	...	...	...	
12″	11″	13″	...	...	...	
11″	17″	8″	...	..	...	
12″	13″	12″	...	...	...	
12″	13″	12″	...	...	..	Area of Nursery 2,409 square feet.
10″	9″	3″	...		...	
13″	9″	7″	..	...	...	
10″	8″	10″	...	...	...	
17″	10″	14″	...	...	...	
14″	17″	8″	...	...	...	
8″	9″	9″	...	...	...	
13″	16″	10″	...	...	...	
11″	10″	9″	...	...	...	
Number of trees measured . .		63	2	4	1	

This gives 1,261 trees per acre, from 3 to 25 inches in girth, at breast high, and with an average height of from 30 to 40 feet.

Mr. Culcheth has kindly given me the following information regarding this plantation. The seed was put down in the rains of 1870 in order to form a nursery. The trees were not transplanted, and they have remained ever since, a few now and then being cut to thin the plantation. The rapid growth of the trees is due to the moisture in the soil, which is caused by percolation from a natural tank about one-fourth of a mile south of the bungalow. The well which is just below the bungalow often overflows.

Sowing

26. As regards sowing, the experience hitherto gained has shown that broadcast sowing in ploughed land answers well. By this method good success has been attained with Bábul, Khair, Jhinja, Khákra, and Kalia (the black Siris) in the following places: Barinal in Taragarh, Mohwa Bir, Chang forest, Chang and Dilwara Birs, near Beawar, Biliawas, and in numerous places in the Todgarh Reserve. In the two small Birs near Beawar, the seed of these trees was sown together with til, bajra, and other kharif crops. In places fit for the plough this plan is a good one, and should be continued. The drawback to it is that the grass is rooted up by the plough, and that the plants have not sufficient shelter against frost and sun.

Sowing in continuous horizontal lines

27. In places where ploughing was not practicable sowings have been made in patches dug up by a small hand-spade ("kurpa.") This has also succeeded well, but unless these patches are arranged in regular lines, control and filling up of blanks are difficult. In such places I recommend that the work should be arranged in continuous lines, and that in hilly and undulating ground these lines should run horizontally. In these lines patches should be selected in suitable positions where there is soil, and where rocks, shrubs, or tufts of grass afford shelter. On level or gently undulating ground it will suffice merely to dig up

the surface of these patches, while on steeper slopes it will be necessary to dig shallow pits, the soil being heaped up near the lower edge, and the seed being sown in the pit and on the edge of it. These pits should not be more than 6 inches deep, and their diameter must vary according to circumstances. Attempts have been made to sow seed on the earth heaped up over pits which have a small circular ditch dug round them, and also to dig parallel trenches along the hill sides, and to sow the seed both in the trenches and on the mound of earth produced by their excavation. These attempts have generally not been successful. The circular ditches were probably too deep, and on undulating ground the trenches deepen into drains, and tend to dry up the ground; so that, upon the whole, it is possible that shallow patches or pits will answer better. Whatever system may be adopted, the pits or patches should be in continuous lines, so that the success or failure can be seen at a glance. These lines may be at distances up to 30 feet apart, and the grass should be left standing in the lines so as to afford shelter to the young plants.

Seasons for planting and sowing.

28. As regards the seasons for planting and sowing, experience has shown that plants from the nurseries must be planted out at the first heavy rainfall. There is always a risk of the fall being succeeded by a period of hot weather which may kill the plants; but the risk is unavoidable in all transplanting operations in these districts. Sowing has generally hitherto been commenced after the first heavy fall of rain, and in the case of broadcast sowing on ploughed land it is necessary to select this time, as ploughing is impracticable until the ground has been moistened; but in the case of the patches and shallow pits here recommended, the experiment should be made of sowing in the hot weather before the commencement of the rains. It should, however, be mentioned that some experiments made in hot weather sowing on Nagpahar have failed.

The chief trees to be raised by sowing in these forests are Khair (*Acacia Catechu*), Kália, the black Siris, (*Albizzia odoratissima*), the Indian Elm (*Ulmus integrifolia*), Bábul, Ber (*Zizyphus nummularia*), and in sandy places *Ailanthus excelsa*. Experiments to raise Dhaukra (*Anogeissus pendula*) have hitherto failed, but they should be persevered with; the seed ripens in January, and possibly it should be sown at once to attain success. It should be tried both in nurseries and in the forest until it succeeds. *Dalbergia Sissoo* has hitherto only succeeded when raised in nurseries and planted in valleys and other moist places, and when it is watered for two or three years. In other localities the dry atmosphere is probably against it.

Principal trees in the Reserves

29. It will now be well briefly to describe the most important trees which constitute the present forest growth in the Reserves.

Dhaukra

Dhau, Dhaukra, Dhokra (*Anogeissus pendula*). This tree has a much more limited range than the broad-leaved species, Goria or Golia Dhau (*Anogeissus latifolia*), which is also found, though much less common, on the hills of Merwara. *A. pendula* extends from the Aravalli range to the hills in the Hamirpur and Banda districts; and from Rupnagarh (Kishengurh) in the north, to the Narbadda near Punassa, in the south. At a glance it may be distinguished by its smaller leaves and elegant slender drooping branchlets, and by the peculiar reddish brown colour of the foliage in the cold weather. In these districts the old leaves fall in February and March, and it clothes itself with fresh foliage towards the end of the hot weather. It flowers in October, and the seed ripens early in January. It is the chief tree which composes the sacred and other protected forests in Rajputana, and forms almost pure forests of considerable extent, generally occupying the lower and more gentle slopes of the hills.

Reproduction from seed and from coppice shoots.

30. Its reproduction from self-sown seed does not appear to be very vigorous, and there is as yet no considerable reproduction from self-sown seed even in the forests which have been longest under protection. The annual rings cannot readily be distinguished, and I have no information regarding its rate of growth. There seems no doubt that it coppices, but certainly the coppice shoots are not as vigorous as those of some other trees, for instance the "Ber" (*Zizyphus*). The attention of the officers charged with the management of these forests should be directed to the study of the habits of this tree, chiefly as regards its reproduction from seed and by coppicing.

Experimental fellings of Dhaukra

31. With a view to gaining information on this subject, it will be necessary to make cuttings on a considerable scale in localities favourable for the growth of this tree. In making these cuttings a certain number of seed-bearing trees of this species should always be left standing, and the trees should be so cut as to enable them to throw up coppice shoots. These experimental cuttings of Dhaukra will have a two-fold object, *viz.*, to produce revenue and to furnish data regarding its powers of reproduction. They should be made in the following localities:

First.—At the back of Nagpahar, cuttings should be made in some of the better stocked valleys and ravines near the base of the hill. The wood here cut will find a ready sale at Ajmere. The rafters of the houses in the greater part of Merwara are cut from this tree, and the wood is also used for fuel and charcoal.

Second.—In the Chang forest, near its north end, and in the central valley. The wood here obtained can doubtless be sold for fuel and rafters.

Third.—At the southern end of the Todgarh tract, near Pipli, and at the back of Goramji. The wood here cut will probably find a sale in the open country about Deogarh.

Fourth.—In the northern end of the Todgarh tract near Bagri. The material can be used for charcoal and perhaps for rafters to supply Nusseerabad and other large towns.

Arrangement of fellings.

32. I recommend that the fellings of each season be made in one locality, and that they be sufficiently extensive to justify special supervision. Each felling should be limited to a well defined area. No trees should be cut where the forest is scanty or the ground precipitous or very rocky. Great care should be taken not to cut more wood than can readily be sold. During my visit (December) two small experimental cuttings were made in the Dudalia block of Todgarh tract near Mahadeo, consisting of forty-three and forty trees respectively. The diameter of the trees cut was between 5 and 14 inches, and the height ranged between 20 and 34 feet. The stumps were cut close to the ground, and were smoothed so as to serve as samples of how the work should be done, but it is not likely that trees cut during the cold season will throw up vigorous shoots. This at least is the conclusion I have formed by examining several trees which were cut in the cold weather of 1874, and some of which had not thrown up any shoots, while others had coppiced indifferently. The fellings therefore should be made in March, or if possible later in the season. Different methods of selecting the trees to be felled should be adopted in the various localities. In some places a larger and in others a smaller number of trees per acre should be left standing for seed and shelter. Again, it is possible that the Dhaukra may be better adapted for pollarding than for coppicing, and therefore some trees should be pollarded on a limited area in each season's fellings.

Record of operations

33. An accurate and detailed record of each season's operations should be kept, and it should be illustrated by a sketch map of the area cut over, on which the limits of the plots treated on different plans should be shown, so that they may be identified on the ground. In the book containing the record of these fellings an annual statement should be recorded of the success as regards reproduction by coppicing, pollarding, or from seed.

Disposal of the cuttings.

34. It will probably be necessary on account of the distance of the principal markets to convert a considerable portion of the material into charcoal. There will be a difficulty in burning charcoal during the hot weather on account of the danger from fire, but this risk may be considerably diminished by making large conical kilns. These can only be made in valleys or ravines where there is water, and where it will not be difficult to guard by fire lines against the spread of fire. The cutting and collecting of the material along the sides of the paths used for export, or at the places selected for the kilns, should be carried out departmentally; but Government should not undertake the carriage of material away from the forests. In December 1876, a large quantity of old dry trees were cut, and charcoal was made by departmental agency in the Todgarh tract near Ganeshpura, but a considerable part of the charcoal was stolen, and the experiment proved a failure This, however, seems to have been due to faulty management, and there is no good ground for anticipating failures, provided the management is good.

35. Next to Dhaukra, the most common tree is the well-known Saler (*Boswellia thurifera*), a deciduous tree with rough grey bark and pinnate leaves, which is abundant on the ridges and upper slopes of all hills. The principal use at present made of this tree is to feed cattle by lopping off the branches, and the wood is also used for fuel, and troughs for irrigation; cups and plates are also made from it, but as far as I have been able to ascertain the gum is not collected. I do not recommend any cuttings of this tree at present. It is well known to coppice and pollard vigorously, and in all forests protected for a sufficient time, the ground is covered with self-sown seedlings, which will soon grow up into saplings and poles. Eventually, perhaps, it may be possible to turn this tree to good account, and to produce revenue from it. Meanwhile its spread is useful in so far as it helps to cover the ground and will thus facilitate fire protection, and the growth of other more useful trees. **Saler.**

36. Gol (*Odina Wodier*), a deciduous tree with pinnate leaves and entire leaflets, is commonly associated with Saler. The wood is hard and strong, and will probably eventually be in demand for building or charcoal. The tree should not be cut at present, and its growth should be encouraged. **Gol.**

37. More important but less abundant than Saler and Gol is Kher (*Acacia Catechu*). This tree is known to reproduce easily from seed. It should not be cut at present, but its spread should be encouraged as much as possible, and as above explained it should be sown on a large scale. **Kher.**

38. The black Siris, commonly called Kalia in these districts (*Albizzia odoratissima*), is probably one of the most promising constituents of these forests. The tree is common in all the reserves from Nagpahar to Dewair; it is a more rapid grower than any of the species yet mentioned, and it forms straight well shaped poles. Self-sown seedlings are numerous, and, as already stated, this tree should be propagated as much as possible by sowing or planting, and it will probably be found a most useful associate of Dhaukra. **Black Siris.**

39. Another tree which requires special mention is the Soap nut—Ritha, Aritha (*Sapindus emarginatus*), with soft, hairy, pinnate leaves, which is indigenous in the southern part of Merwara, where the seed is collected and sold. The growth of this tree should be carefully encouraged, and it should be propagated by planting. **Soap nut.**

40. The chief trees in valleys and near streams are the following: The Indian Elm, Cherril, Surril, Chirlia, Sirlia (*Ulmus integrifolia*), a large shady tree, also common near villages; the wood is valued for agricultural implements and fine specimens are to be found at the Baer Temple, at the foot of Goramji, with an abundance of self-sown seedlings, which have dentate leaves. Keim (*Nauclea parvifolia*), and Jaman (*Eugenia Jambolana*), of which there are two forms, or perhaps species, one with broad, the other with narrow leaves. With these is often associated Bahera (*Terminalia bellerica*), and Umbri (*Ficus glomerata*). Fine specimens of these species are found along the principal valleys which descend from the Merwara hills westward to the plains of Marwar, such as the valleys at the foot of the Goramji hill and in the Dewair nal. These kinds are useful trees, and their growth should be encouraged in all suitable localities. **Trees in valleys and near streams.**

41. The following trees are widely spread throughout the reserves:— **Trees of less importance.**

(1) Umbia (*Saccopetalum tomentosum*), not uncommon on the hills of Merwara, fine specimens in valleys.
(2) Brarna, Varana (*Cratæva religiosa*), only found as a shrub.
(3) Semla (*Bombax malabaricum*).
(4) Karr (*Sterculia urens*), a soft-wooded deciduous tree, with smooth white bark and thick white branches, the gum of which is collected in other parts of India.
(5) Mutrúk (*Sterculia colorata*), rare.
(6) Kari or Keiri (*Feronia Elephantum*), rare.
(7) Bilan (*Aegle Marmelos*).
(8) Rohan (*Soymida febrifuga*), rare.
(9) Gadichora (*Erythrina suberosa*), the only species of this genus found in these hills.
(10) Chora, Shora, Chachra, Khakra, Kankra (*Butea frondosa*), common wherever there is sufficient depth of soil, in depressions in valleys and on level ground.

(11) Shisham (*Dalbergia latifolia*), the rosewood of South India, attains its north-west limit in the hills of Merwara, and is not uncommon in the Todgarh tract, on Goramji, and other high hills, though it does not attain any large size.

(12) Passi (*Dalbergia lanceolaria*), not uncommon.

(13) Jhinja, jija (*Bauhinia racemosa*), a slow-growing tree, with dark-coloured heart-wood.

(14) Kirmalia (*Cassia fistula*), scarce and small.

(15) Khejra (*Prosopis spicigera*), the Jhand of the Punjab and Kundi of Sind; a tree characteristic of the arid and dry zones of India (also in the southern dry zone of the Deccan), is not uncommon among these hills. It makes good charcoal and produces edible pods, known as Hangri or Sangri.

(16) Arinj or Ajmeri (*Acacia leucophlœa*), a small tree here, which attains a large size in some of the tropical forests on the Godavery and in Burma; easily known by the long panicles of long slender curved pods at the end of the branches. If protected it will probably attain a large size and yield useful timber.

(17) Lunia (*Hymenodictyon excelsum*), scarce and of small size.

(18) Timbru, tibru (*Diospyros melanoxylon*), Merwara, not common, and generally small.

(19) Mokha (*Schrebera swietenioides*), not common in Merwara.

(20) Khirni (*Wrightia tinctoria*), with long round pods in pairs, is found in almost all Reserves.

(21) Three species of *Cordia*: Lasora, Gunda (*Cordia myxa*), a narrow-leaved variety, common in the Chang forest, with bright green foliage, in leaf in December.

(22) Godela (*Cordia Macleodii*), a small tree with large soft grey leaves and dark-coloured, beautifully-veined heartwood.

(23) Gundi, Gondi (*Cordia Rothii*), with narrow linear leaves, common on rocky hills, fruit eaten, ripens in July.

(24) Sewan (*Gmelina arborea*).

(25) Paras pipal (*Ficus cordifolia*), with large glabrous, heart-shaped leaves; here a small knotty tree on rocks and precipices.

(26) Kembri (*Ficus virgata*), common near villages, with woolly leaves and edible fruit.

(27) Lamkana (*Briedelia retusa*), with large-ribbed leaves, not common, and the specimens found were small. This tree should be encouraged.

(28) Aonla (*Phyllanthus Emblica*).

Cultivated trees

42. Of trees which are not indigenous, but are cultivated, the following may be noted :—

(1) Arua (*Ailanthus excelsa*), thrives well on sandy soil.

(2) Nim (*Melia indica*), a valuable timber tree, which grows well and readily, and the spread of which should be encouraged everywhere.

(3) Bakain (*Melia Azedarach*), should be cultivated in the reserves.

(4) Ber (*Zizyphus vulgaris*), should be grown in valleys and other moist places in the reserves. Coppices remarkably well.

(5) Kurrus, Karija (*Pongamia glabra*), commonly planted near road sides; fine specimens, and an abundance of self-sown seedlings, at the Baer temple, at the foot and on the north side of Goramji hill.

(6) Babul (*Acacia arabica*), common, self-sown throughout the district, but not indigenous.

Shrubs: species of Grewia.

43. Besides these larger trees, these forests contain a large number of smaller trees and shrubs, of which the following are the most important. :—

Six species of *Grewia*, which are all characteristic shrubs of these hills, *viz.*, *Grewia pilosa* (Pisangan or Parangan), a scrambling shrub, abundant almost everywhere on stony ground in Ajmere and on the outskirts of forests in Merwara, with long angular branches; *Grewia salvifolia* (Heriss, Seriss, Sarisa), a small shrub with leaves grey underneath, commonly found on dry rocky hills; *Grewia populifolia* (Gangan, Gangerun), a shrub with small

leaves, pretty white flowers, and orange-coloured berries, has a hard, white wood, and makes excellent walking sticks; *Grewia villosa* (Dhokelan), a small shrub, with large, round, soft, hairy leaves; *Grewia asiatica*, with broad, rough, green leaves; and *Grewia vestita*, with narrower, grey leaves: the two last named often growing together, for instance, on the top of Nagpahar, but always readily distinguished. It has been doubted whether these last two should be regarded as species or merely as varieties, but in these hills they are quite distinct, and it seems probable that the mother plant of the Phalsa (*Grewia asiatica*), a fruit tree commonly cultivated in gardens throughout North India, is wild on the dry hills of the Aravalli range.

Other shrubs.

44. (1) Three species of Capparis: *Capparis aphylla* (Khér), with numerous green leafless twigs and red berries.

(2) *Capparis horrida* (Gitoran), with tomentose leaves;

(3) *Capparis sepiaria* (Katán).

(4) Brarna, Barana (*Cratæva religiosa*), only attaining the size of a large shrub or a small tree in these districts.

(5) Kekéran, Kakéran, Kainkeri (*Flacourtia sapida*), a thorny shrub, with edible berries.

(6) Marór phalli (*Helicteres Isora*).

(7) Hingota (*Balanites ægyptiaca*).

(8) Gugal (*Balsamodendron Mukul*), a stunted, deciduous shrub, with thick, spreading branches, bark ash-coloured, peeling off in rough flakes, leaving exposed the under-bark, which is bright and shining, and peels off in rolls like thin paper. This shrub yields a fragrant gum-resin, which is similar to the Myrrh of commerce.

(9) Kakaira (*Celastrus senegalensis*), a rigid and thorny shrub, with grey leaves; common on rocks and in dry places.

(10) Bhor, Jhalbhor (*Zizyphus nummularia*), with globose edible plums, ripening in December; common everywhere and gregarious, often covering large tracts of country.

(11) Dasan, Davan, Dasni (*Rhus mysorensis*), a small thorny shrub, with aromatic leaves and edible berries, which are sold in the bazar; bark used for dyeing leather.

(12) Soonjna, Sainjna, Segora, Hegu, Segu (*Moringa concanensis*), closely allied to the Indian horse-radish tree (*Moringa pterygosperma*).

(13) *Dichrostachys cinerea*, a thorny shrub, with grey branches and long straight, often leaf-bearing thorns, easily known by its bunches of twisted pods and short bi-coloured flower-spikes, the lower part purple, the upper yellow; is common in places, *e. g.*, along the foot of the Nagpahar on the west side, but is not found everywhere. In Ajmere it is called Kheri, while in Merwara it is generally known as Kunlái, Kanlai.

(14) On sandy soil is not uncommon *Acacia Jacquemonti*, closely allied to *Acacia arabica*, but quite different in habit. It is a straggling bush, with long, slender, reddish branches, white thorns, and sweet-scented yellow flowers.

(15) Very characteristic for the hills of these districts is Kumta (*Acacia rupestris*), a knotty and very hardy shrub, sometimes a small tree, with white or light grey bark, stout, sharp thorns, generally in threes under the axil of the leaf; long, white flower spikes and broad, flat pods; peculiar to the arid and sub-arid regions of India, being common on the dry hills of Sind, and extending westward over Arabia and the drier parts of Africa. It is common on rocky hills, as well as on sand drifts, which are a common feature in valleys opening west towards Marwar.

(16) Dharni (*Woodfordia floribunda*), not uncommon in Merwára.

(17) Mehndi (*Lawsonia alba*), not common.

(18) Ghatolan, Karumba (*Randia dumetorum*), not common.

(19) *Salvadora persica*, on saline soils.

(20) A common shrub is Tambolia (*Ehretia lævis*), with grey bark and dark, green, ovate leaves, particularly abundant in Merwara.

(21) Urni (*Clerodendron phlomoides*), in hedges and near villages.

(22) Thor (*Euphorbia Nivulia*), a succulent shrub, often 15 feet high, consisting of dense masses of green, round, fleshy stems, with whorled branches and spirally arranged spines, forms a marked feature in the scanty vegetation of the rocky hills of Ajmere. In many places, and before protection commenced, this shrub was the last remnant of the natural vegetation, with the exception of a belt of Sâler (*Boswellia*) along the crest of the hills, and of a fringe of Dhaukra and a few other trees along the valleys. When nothing else can be got, the stems and branches of "thor" are used as fuel, but it is not much valued and has therefore generally been spared. It is, however, useful so far as it shelters seedlings of trees, particularly of Nim, which often germinate and grow up under its protection, and which, if exposed, would have been eaten by cattle. In Merwara "thor" is less common, and in the southern part of the district it is wanting.

(23) *Mallotus philippinensis*, found by me only in the southernmost corner of Merwara, near Dewair.

(24) Common on rocky hills is Salépan, Halépan, which name comprises two species, *Securinega obovata* and *Securinega leucopyrus*.

(25) *Dendrocalamus strictus*, the common Indian bamboo. Groups of clumps, mostly small and much hacked, are found here and there on rocky ground.

(26) In the bed of larger streams are found Néger, Négra (*Vitex Negundo*); and

(27) Jhau (*Tamarix dioica* and *gallica*.)

Under-shrubs, creepers, and herbs.

45. Several under-shrubs merit notice, as they are common and form a characteristic feature in these districts. Padéra, called Atovan in Merwara (*Hamiltonia suaveolens*), with large ribbed leaves and woolly erect panicles of blue, scented flowers. Chetul (*Plumbago zeylanica*), with smooth, grey leaves and panicles of reddish-brown flowers. Awal (*Cassia auriculata*), with yellow flowers. *Orthanthera viminea*, with long, slender, green branches, which are almost leafless.

Creepers are rare in these hills. The chief are Kabonan (*Phyllanthus reticulatus*); Musal, Murie, (*Vitis latifolia*); Katamba (*Vitis carnosa*); Chirmi (*Abrus precatorius*); Gora Bel (*Butea superba*); Kanguni Bel (*Celastrus paniculatus*); both found in the Dewair forest.

In the protected reserves one of the most common grasses is the scented lemon grass (*Cymbopogon Nardus*). The bottom of tanks in Merwara is filled by dense masses of a *Chara*, with a strong smell of sea-weed.

General character of arborescent vegetation in Ajmere and Merwara. Outside the range of Teak, Sal, and Sissoo.

46. The general character of the arborescent vegetation in these districts is similar to that on the hills of Central India, north of the Nerbudda river, with the addition of a few species belonging to the more arid regions of India. But a large number of species are wanting, which are common further east, and which also occur in the Sub-Himalayan tract. Ajmere and Merwara are entirely outside the natural range of the three chief timber trees of the tropical and sub-tropical regions of India—teak, sâl, and sissoo. The climate is too dry and not warm enough for teak and sâl, and though it may be possible to keep a few teak trees alive in gardens at Ajmere, the cultivation of this tree, or of sâl, should not be attempted on a large scale. Sissoo, on the other hand, grows well, and should be grown extensively; but sissoo is a native of a much colder climate—the Punjab and the Sub-Himalayan tract.

Trees of the Peninsula and Central India.

47. Of the trees which, like teak, attain their northernmost point in Central India and are not found in the Sub-Himalayan forests of Northern India, a few occur in these districts. These are *Soymida febrifuga*, *Dalbergia latifolia*, *Cordia Macleodii*, and *Wrightia tinctoria*. Others are wanting, and of these it will suffice to mention *Chloroxylon Swietenia*, *Hardwickia binata* (nearest point Chandgarh, north of the Nerbudda river), *Pterocarpus Marsupium* (found in the Santolah forests, south-west of Neemuch), and *Spathodea falcata* (Bassi forests, north-east of Chitor).

Trees of the Peninsula and of the Sub-Himalayan tract.

48. Of the trees which are found in the Peninsula and in the Sub-Himalayan belt, those which extend far to the north-west in the Punjab are mostly found in these districts. Among them are—*Bombax malabaricum*, *Odina Wodier*, *Cassia Fistula*, *Albizzia odoratissima*, *Acacia Catechu*,

Terminalia bellerica, *Eugenia Jambolana*, and *Phyllanthus Emblica*; which all extend to the Indus. In addition to these a number of Sub-Himálayan trees are found, which do not extend so far. Of these may be named the following, their north-west limit being placed opposite the names: *Dendrocalamus strictus* (Jhelum), *Briedelia retusa* (Chenab), *Anogeissus latifolia*, *Hymenodictyon excelsum*, and *Diospyros melanoxylon*, (Ravi), *Stephegyne parvifolia* and *Ulmus integrifolia* (Bias), *Boswellia thurifera* (Sutlej), *Sterculia urens* and *colorata*. (Jumna), and *Schrebera swietenioides*, which only occurs as far as Kumaun. But, as a rule, none of the Sub-Himalayan trees, which are not indigenous north of the Ravi river, occur in Ajmere and Merwara. The following are the principal of this class of trees which have not yet been found in these districts:—*Elæodendron Roxburghii*, Ravi; *Schleichera trijuga*, Sutlej; *Buchanania latifolia*, Sutlej (found further south in the Aravalli hills); *Ougeinia dalbergioides*, Sutlej; *Albizzia procera*, Jumna; *Terminalia Chebula*, Sutlej; *Terminalia Arjuna*, Jumna; *Terminalia tomentosa*, Ravi (nearest point Bassi forest, Meywar); *Eugenia operculata*, Jumna; *Careya arborea*, Jumna; *Lagerstrœmia parviflora*, Jumna (found in Banswara); *Alangium Lamarckii*, Ganges; *Adina cordifolia*, Jumna; *Wendlandia exserta*, Chenab; *Alstonia scholaris*, Jumna; *Stereospermum suaveolens*, Jumna.

Some of these may yet be found, for the botanical exploration of this particular tract of country is as yet fragmentary, and the present remarks are published in order to induce others to add to the observations which have been made, and thus to bring together the data upon which some day a complete account of the geographical distribution of the timber trees of North-West India may be based.

Construction of dams across valleys in the reserves.

19. An important work for the improvement of the protected areas, of which as yet only the first commencement has been made, is to build small embankments across valleys and ravines, in order to retain the silt and to form soil for planting. Such works should be undertaken systematically, as far as funds may be available. In valleys with a steep slope, dams or embankments at suitable places, for instance at the edge of terraces or steps, will be found useful; while in valleys with a more gentle slope, spurs in an oblique direction, projecting from either bank into the bed of the stream, will probably be preferred. The work here recommended to be undertaken is analogous to the admirable system of "barrages," constructed in the French Alps and other mountains of Southern France in connection with the works of "reboisement." After the space above such spurs or dams has filled up with silt and loose soil, these areas are planted up, and these works have been found to be most useful adjuncts to the planting and sowing undertaken on the rest of the areas operated upon. In the Pabbi Rakh, in the Gujrat district of the Punjab, similar work has been executed with considerable success under the control of Mr. Baden-Powell, the Conservator of Forests in that Province.

An interesting memorandum on this subject by Mr. W. Culcheth, the Executive Engineer of Irrigation Works in Ajmere, in which the construction of a system of dams in the hills of Ajmere and Merwara is advocated, is appended to the present report.

CHAPTER III.

ADVANTAGES EXPECTED FROM THE PROTECTION OF THE RESERVES.

Beneficial effect of the protection of the reserves.

50. When the formation of the State forests in Ajmere was decided upon, the idea was that the protection of these areas would increase the supply of wood and grass, and would improve the water-supply in wells and tanks. Protection has not yet been continued long enough to furnish definite results, but certain facts bearing upon the question of the beneficial effect which the protection of these reserves has had, and which it may be expected to have upon the well-being of these districts may here be recorded.

Increased supply of grass.

51. The difference in the condition of the forest growth inside and outside the protected blocks is very marked; the forest growth is more dense and grass is abundant. The increased supply of grass for cattle fodder must be

regarded as one of the chief advantages to be derived from the protection of these reserves, and it is an important question how best to utilize it. In the present open and incompletely stocked state of the forests, cattle cannot yet safely be admitted. Grazing in these forests at present would indefinitely retard their improvement. At a future time, when the forest has grown up, pasture, except for camels, sheep and goats, can doubtless be permitted in selected blocks without injury to the forests. In the Ajmere district a large portion, and in some reserves the whole crop of grass which is produced annually is cut by the villagers either for local consumption or for sale.

The increased supply should be better utilized.

52. In Merwara this is only the case in a few places, and much of the grass produced remains unused. It is very important that an effort should be made to induce the people of Merwara to cut grass and to use it outside the forests.

Private grass preserves in Merwara

53. In many villages of this district, a portion of the hills and other waste lands included in the holdings of the shareholders is set apart as grass preserves. In these preserves the grass is cut in the cold weather, and lines of stacks stored up for the long and hot dry season may be seen near the villages. These grass preserves or "biras" are generally nearer the villages than the State Forests, and the answer usually given by the people is that the cutting and bringing home of grass from these is too troublesome, because the distance from their villages is too great. Permission should be given to carry away the grass on ponies and donkeys, and every facility should be afforded to enable them to do this. At present it is customary for villagers who wish to cut grass to submit a petition, but it is for consideration whether it is necessary to continue this or whether it would not be preferable to issue licenses to all zemindars who are entitled to the privilege, which licenses would authorize them to cut grass throughout the year.

Of minor forest produce the only articles which yield revenue at present are wax and honey, and these are collected by the Bhils who receive one-third of the produce as remuneration. In 1877-78 the amounts realized were Rs. 40 for honey and Rs. 20 for wax.

Possible influence of forest conservancy upon the rainfall.

54. The crops, and hence the prosperity of these districts, entirely depend upon the quantity and distribution of the rainfall throughout the year, but it is very doubtful whether we are justified in expecting that the protection and improvement of the forest growth in the areas demarcated as State forests on these hills, will have any marked effect upon the rainfall of the district. The quantity and distribution of the rainfall will be best understood by stating the fall during each month of the year at the two principal stations, Ajmere and Beawar—

Mean annual rainfall in inches.

	Ajmere. 13—14 years.		Beawar. 23 years.	
Elevation above sea	1,568 ft.		1,465 ft.	
January	0·67 inches.		0·22 inches.	
February	0·41 „		0·21 „	
March	0·30 „		0·20 „	
April	0·15 „		0·12 „	
May	0·52 „		0·41 „	
June	2·01	20·01 in.	2·20	19·28 in.
July	6·45		7·82	
August	7·62		6·36	
September	3·93		2·90	
October	0·27 inches.		0·23 inches.	
November	0·13 „		0·20 „	
December	0·40 „		0·20 „	
TOTAL	22·86 „		21·07 „	

The Ajmere figures were obtained from the report on the meteorology of India for 1877, while those for Beawar are taken from a statement drawn up by Mr. W. Culcheth, Executive Engineer, Irrigation Division, Ajmere, a copy of which is appended to the present report.

Beawar is 32 miles to the south-west of Ajmere; the elevation of the two places is nearly the same, but while Beawar is situated in an open, slightly undulating plain, Ajmere is surrounded by hills, of which Taragarh is 2,855 feet, Nagpahar 2,760 feet, and Madar hill 2,623 feet. Hence, the rainfall of Ajmere may reasonably be expected to be somewhat heavier than that of Beawar. As regards the seasons, it may be said that there is a long dry season from October to May, and a short rainy season from June to September.

Ajmere and Beawar.

The two stations give a fair representation of the rainfall throughout the district save in the southern or more hilly portion of Merwara, where the fall is heavier. Thus, the average of Todgarh during a period of eight years is reported to be 23·85 and of Dewair 27·49 inches. The last-named figure, however, is doubtful.

The rainfall very variable.

55. A remarkable feature in the rainfall of these districts is the great variation in the quantity of the annual and monthly fall. At Beawar, during the 23 years to which the observations relate, the highest fall, 42·70 inches, occurred in 1862-63, while the lowest fall, 6·80 inches, took place in 1868-69. In June 1863 there was a fall of 9·5 inches, while no rain at all fell in June 1858 and 1869, and less than an inch in June 1860, 1864, 1865, 1868, 1870, and 1873. In July 1862 the fall was 23·50, while in 1857 the rainfall of July was only 1·2 inch. In August 1872 15·80 inches fell, while in 1858, 1868, and 1877 the fall of that month amounted to less than one inch.

Mr. Culcheth has also furnished me with an interesting statement, a copy of which is appended to this report, exhibiting the great variation in the rainfall observed during the same period between different places situated at no great distance from each other. Thus, in September 1875, the following quantities fell at Jawaja and at Masuda, which two places are only 22 miles apart and have nearly the same mean annual rainfall:—

Rainfall in inches.

	Mean annual fall.	September 1875, 19th—25th.	Whole month.
Jawaja	20·39	18·68	28·02
Masuda	20·42	8·50	9·80

In September 1876 the following quantities fell at Beawar and at Ajmere, the distances between the two places being 32 miles:—

Rainfall in inches.

	Mean annual fall.	September 1876, 3rd to 9th.	Whole month.
Beawar	21·07	6·62	9·
Ajmere	22·86	1·80	3·40

Much larger quantities fell at Dewair during the corresponding periods, but there is some doubt regarding the rainfall observations at that place.

It might be thought that the great variations in the rainfall of the same place in different years, and in the rainfall during corresponding periods at different places near to each other, would justify the supposition that the rainfall might be increased by improving and increasing the forest growth on the hills. There is, however, no ground for this supposition, and the irregular character of the rainfall must rather be ascribed to changes in the upper strata of the atmosphere which have no connection with the clothing of the earth's surface.

Comparative observations of rainfall recommended.

56. In any case the areas now demarcated are too small to justify the expectation that their protection will have any marked effect upon the quantity and distribution of the rainfall. Nevertheless, it will be advisable to make observations regarding the rainfall in and outside some of the protected areas. Observations made in different parts of Europe leave no doubt that over a well-stocked forest the rainfall is heavier and the humidity of the air greater than in the open country. It will suffice here to quote the results obtained by Professor Fautrat, who has made continued meteorological observations in the forests of Halatte and Ermenonville. The observations made during the twelve

months from August 1876 to July 1877, were submitted by him to the Academy of Sciences in August 1877, and the chief results are as follows:—

	Deciduous forest.	Pine forest.
Above the forest	932 mm.	848 mm.
Outside	901 mm.	792 mm.
DIFFERENCE	31 mm.	56 mm.

The station above the forest was 14 metres above the ground in the case of the deciduous and 12 metres in the case of the pine forest, and distant in both cases 300 metres from the station outside the forest.

A similar difference was noticed in the humidity of the air, the mean relative humidity during the same period and at the same station being as follows:—

	Deciduous forest.	Pine forest.
Above the forest	71·6 per cent.	67·1 per cent.
Outside	68·6 „	60·4 „
DIFFERENCE	3·0 „	6·7 „

Similar results will doubtless be found in India. Observations of this kind should be made in other provinces also, but they are of special importance in the dry and variable climate of these districts.

The selection of the localities for these comparative observations will require considerable care; the stations should be easily accessible, and the conditions in the corresponding stations should be as uniform as possible.

The stations should be at the same elevation and, if near the hills, on the same side of the range. It will be well in each case to establish three rain gauges, one outside the forest, the second inside on a platform above a well-stocked portion of the forest, and the third near the second on a small blank or open spot surrounded on all sides by forest. Considering the great variations in the fall, it will be necessary to continue these observations for a considerable length of time.

Comparative observations of temperature, humidity, and dew.

57. Simultaneously with the rainfall, it will be well, if possible, to make comparative series of observations inside and outside the forest with the maximum and minimum thermometer and the wet and dry bulb thermometer. To these should be added, if possible, the determination of the dew by weighing. All these observations should be made under the control of the Meteorological Reporter to the Government of India, and the returns should be sent to that officer in such forms and at such periods as may be required by him.

Effect upon water-supply and surface drainage.

58. So much regarding the possible climatic effect of the protection of these areas. The effect of forest conservancy on these hills in regulating the surface drainage and in increasing the water supply in wells and tanks, will probably be found to be considerable, and if the reserves are sufficiently extended, their effect in this respect in increasing the fertility of the district will probably eventually be very important.

Broadly speaking, it may be said that in Merwara somewhat more than one-half, and in Ajmere one-third, of the total cultivated area in the Government or Khalsa villages depends upon irrigation of one kind or another. Merwara, being a hilly district, is naturally more dependent upon irrigation than Ajmere, which contains a large area of level ground. This irrigation is either from wells, from tanks, or by means of dams or embankments thrown across valleys or the line of drainage, which have the effect of retaining the water and thus moistening the field above them.

Proportion of cultivated area irrigated and not irrigated.

59. The following figures exhibit the area in acres of these different classes of land in Khalsa villages:—

	MERWARA. Acres.	AJMERE. Acres.	TOTAL. Acres.
Chahi (irrigated from wells)	14,935	18,553	33,488
Talabi (irrigated from tanks)	10,096	8,365	18,461
Abi (moistened by dams)	8,692	7,746	16,438
Total irrigated	33,723	34,664	68,387
Barani or unirrigated	28,773	74,256	103,029
Total cultivated area	62,496	108,920	171,416

The Barani land chiefly produces summer or kharif crops,—jowar, bajra, some pulses as moong and moth, and millet; and of winter or rabi crops, gram and small quantities of wheat and barley. The irrigated land produces, besides cotton and sugarcane, maize as a summer crop, and wheat and barley as winter crops. But the irrigated land is relatively of much greater importance than its area indicates, on account of the much larger yield per acre. Thus, the outturn of grain on well land is estimated by Mr. White, the Assistant Commissioner of Ajmere, at 25 to 30 maunds, and on dry land at 7½ to 10 maunds per acre.

Improved water-supply to lands irrigated from wells and moistened by dams.

60. The crops raised on Barani land would benefit by the protection of the reserves if its effect were an increased rainfall. But, as before explained, there seems no ground for expecting any considerable increase in the rainfall. There seems good ground, however, to expect that the irrigated crops will benefit largely if the areas from which they derive their water-supply are placed under protection. This beneficial effect will, I expect, chiefly manifest itself in the hilly parts of the district, and in the case of land irrigated from wells and moistened by dams. The fields thus watered frequently occupy the bottom of valleys and stretches of low ground among the hills, and if in such cases the hills which enclose these valleys are protected and permitted to clothe themselves with forest, the result will probably be that a less proportion of the rain which falls upon the catchment area will be lost by evaporation, that the surface drainage will be retarded, and that the water, instead of running off rapidly will serve to keep the loose soil which fills the bottom of the valleys moist during a longer period than would be the case if the hills forming the catchment area were denuded. Most of the wells are near the beds of streams, which, though without running water on the surface, have at a varying depth below the surface a stratum of water holding soil which feeds the wells during the dry season. It is probable that this under-ground stratum will retain water longer during the dry season, if the catchment area is protected than if it is denuded.

Experiments to determine the water level in wells.

61. This, however, is as yet only an assumption which should be proved by direct experiments. These experiments will consist in measuring the level and depth of water in wells. The wells selected for these observations should each have its distinguishing number; some should be situated in valleys, the heads and sides of which are protected, and others in valleys which derive their water-supply from hills not under protection. At the mouth of each well a horizontal slab should be selected or be placed in position, and on it should be roughly engraved the number by which the well is designated in the record of these experiments. The depths to be recorded should be measured from this slab in the following manner:—A rod 6 feet long should be laid horizontally on the slab in such a position that 4 feet will extend beyond a point marked on the edge of the slab; a line should be cut on this stone, and the rod should always be laid along this line. At the end of the rod should be an eye, and through this eye will be passed a line with plummet attached, which will be lowered to the bottom of the well, and the depth below the eye to the surface of the water and the bottom of the well will be recorded.

Selection of wells for experiments.

62. In each valley a number of wells should be selected, but it is not intended to take any wells, the ordinary water-level of which is more than 15 feet from the surface. Deep wells on high ground should not be selected. It will suffice to make the observation at each well once a week during the months of March, April, and May, and these observations should, if possible, be continued until the rains have fairly commenced. The water-level in wells which are in use for irrigation naturally fluctuates considerably, but during the months named wells are not much used except for sugarcane and cotton, and therefore it will probably be possible to select wells for these experiments which are not used at all during the months in which the observations are made. Should any well selected be in use, care should be taken so to arrange the time of the observations that the level of the water may be as near its normal state as possible, say early in the morning, or after the well has had several days' rest. It may also happen that the level of water in a well is affected by a well situated above it in the same valley. Such circumstances which may affect the water-level in the wells should be carefully noted and entered in the book which will be kept for the record of these observations. Some of the wells

selected may be found to dry up during the dry weather; but, as far as possible, wells should be selected which are known to retain water throughout the year.

In order to make these observations in a complete and satisfactory manner, it will probably be necessary to dig some wells for the purpose. The diameter of the ordinary wells found in these valleys varies from 8 to 15 feet, but wells dug for the purpose of these observations probably need not be more than 6 feet wide. Isolated wells should be avoided, for it is essential that observations should extend to continuous lines of wells situated in the same valley. This is obviously necessary in order to obtain data for the study of the question how far the water-supply is affected by protecting and improving the forest growth on the hills around the valley in which the well is situated. It will probably be found that some of the wells which will thus be selected are fed by springs, and that others derive their water-supply from what may be termed an underground current, or, perhaps more correctly, a water-holding stratum which may be supposed to exist below the bottom of the valleys, appearing here and there at the surface as a trickling stream which runs for some distance, until it again disappears to continue its under-ground flow. It may be regarded as certain that the water-supply in wells thus situated will be increased by the protection of the forest. The first effect which will probably be observed will be, that as protection progresses and the forest grows thicker, wells which formerly became dry during the hot season will retain water throughout the year.

Wells within the protected areas.

63. I have not been able to fix definitely upon any valleys for the purpose of these experiments, but the following may be mentioned as likely to be suitable, *viz.*, three wells in the Mohwa Bir reserve near the Lohagal road; three wells in the Taragarh tract, in Ajmere, one of which is situated in the Nurchasma, and the other two in the Barinal valley; some valleys in the Todgarh and Biliawas tracts, and the valley between the Borwar and Kotra tracts. Suitable valleys in the protected areas where wells for observations might be dug, are the valley on the south-east side of Goramji and one in the north-western portion of the Chang reserve.

In the Danta tract, which is about to be taken up under the Regulation, a line of wells should be dug, and the observations should be commenced at once, so as to test the gradual change which will take place as the forest growth improves. The same should be done in the Rajausi tract, which has been protected for one year only, and also in any new reserves which may in future be demarcated.

Wells in unprotected localities

64. As regards the water-supply of wells in unprotected hills, it will not be difficult to select localities easily accessible and otherwise convenient. Eventually, these observations may be extended, and may be made in the open country or in valleys situated below the reserves, although their sides may not in all cases be protected; for it will probably be found that the effect of protection will extend considerably beyond the immediate vicinity of the protected area. At the outset, however, these observations should be limited to places where the whole catchment area is either under complete protection, or is not at all protected, so as to ensure clear and definite results.

Selection of wells the special duty of a competent officer

65. The selection of the wells to be included within the system of observations here proposed will require considerable care, and should be made the special duty of a competent officer, who should be deputed to the district for the purpose, and should at the same time draw up a complete set of instructions for carrying out the observations, and in connection with the local authorities arrange by whom and how they should be made. It will probably be found convenient to keep a separate register for each well, and these registers, together with a complete and detailed record of the observations, should be kept in a book in which the localities and the catchment areas of the valleys selected should be carefully described, together with all facts of importance that may be reported by the officers who make the observations. An abstract of the observations made should be entered in the Annual Forest Report.

Discharge of springs and streams

66. In addition to the observations on the supply of water in wells, it will be an advantage if the discharge of certain springs and streams in the forests during the hot weather is measured, and I would particularly recommend the following springs for observation:—

1st.—Three springs at the foot of the Nagpahar, one of which is in the Dudadari estate.

2nd.—The spring near Gujarel in the southern portion of the Todgarh reserve.

3rd.—The spring at the Mahadeo temple near Dudalia, west of the village of Todgarh. The area which feeds this spring is at present only partially protected, and an effort should be made to include the entire feeding area within the reserve.

Where necessary a spout of masonry should be made so as to ensure that the whole of the discharge is measured. The experiment must, of course, always be made at the same point. The value of these observations regarding the discharge of springs will consist in this, that they will show the gradual increase of the water-supply in the springs, which it is expected will follow on the protection of the surrounding forest. These observations, as in the case of the wells, need only be made in the three months of the hot weather, *viz.*, from March to May.

Effect of Forest conservancy upon the filling of tanks.

67. A different question is, how far the protection of the catchment area may be expected to improve the filling and hence the usefulness of the tanks in these districts. In considering this subject, the first point for enquiry is, what proportion of the water which falls upon the catchment area actually flows into the tank. Regarding this important question, Mr. W. Culcheth has made detailed enquiries, the results of which are given in a statement which, with his permission, is appended to the present report. The remarks entered in the last column of the return explain the method employed by Mr. Culcheth in order to arrive at these results. The method followed may in some respects be open to discussion, but the results are sufficiently reliable to serve as a basis for the following remarks.

A small proportion of rainfall flows into tanks.

68. It will be noticed that the proportion of the water collected in the five tanks selected by Mr. Culcheth during the periods over which the observations extended was between 10 and 28 per cent. of the total rain that fell upon the catchment area, the mean being 18 per cent.

Bir tank.

The Bir tank, which received the smallest proportion (only 10 per cent.) is a fine sheet of water, formed by bunding up the Bir valley by a dam, built entirely of masonry across a gap between two steep hills. Its principal feeders are the two branches of the Bir nala, draining an area of $8\frac{1}{3}$ square miles, about two-thirds of which, being situated on the eastern branch, is protected, while the remainder of the area on the western branch is outside the reserve. In the catchment area the rock is laminated mica schist, and the soil is light and sandy. Springs are numerous, and at the time of our visit in December several of the streams feeding the tank had running water, and these streams and springs contribute largely to the water-supply of this tank.

Bulad tank.

The Bulad tank received the largest proportion (28 per cent.). The catchment area is $12\frac{1}{4}$ square miles, a large portion of which is cultivated. There are four moderate-sized tanks in the catchment area, the leakage from which affords a supply of water long after the rains.

The larger tanks filled only by heavy falls of rain

69. Mr. Culcheth ascribes the smaller proportion of water that finds its way into the Bir tank to the more retentive character of the soil, and on this subject, as well as regarding the filling of tanks generally, I give, with his permission, the following extract from a memorandum which he was good enough to write for me in December last :—

"The tanks generally are filled by a heavy fall of rain, and not by a number of light showers. One day's heavy rain has often filled the largest tanks when the rainfall of a week, or even of a whole month, though much greater in amount, has failed to do so. On the 27th June 1871, the Bicharli tank at Beawar filled and the weir overflowed after a fall of 4 inches up to 7 P.M. of that day, whereas a fall of 7·79 inches in the week ending 4th August 1874, and another of 12·91 in the week ending 25th September 1875, both failed to fill this tank.

"Streams flowing into a tank tend to keep up the water level, which is being constantly lowered by evaporation and absorption or percolation; but unless the streams are large in proportion to the surface area of the tank, the net result is not appreciable. A loss of half an inch a day (not an unusual quantity for evaporation and absorption combined, after the rainy season) over an area of one acre would be met by a stream of ·02 cubic feet of water a second, or only about $\frac{1}{5}$th of the quantity drawn from a well when worked in an ordinary manner; whereas the same loss over an area of 200 acres (not a very large tank—the Anasagar—has a spread of nearly 900 acres when full) would require a stream of 4·2 cubic feet per second, a very considerable stream in this district.

"The most notable instance of the effect of streams that I have observed was at the Bir tank in October 1875. On the nights of the 23rd and 24th September 1875, there were unusually heavy falls of rain all over the district. The water in the Bir tank rose over 10 feet in two days, and on the 25th of the month the depth of water in the tank was 23 feet 10 inches and the submerged area 4,287,000 square feet (98 acres). The water continued to rise for 35 days afterwards, and by the 31st October there had been an increase of one foot in the depth, and the spread had become 4,520,000 square feet (104 acres). In this interval there was not a single shower, and, if I recollect rightly, not a cloud in the sky. The whole of the increase, 4,402,000 cubic feet in the 35 days, an average of 1·46 cubic feet a second (this does not take into account the quantity lost by evaporation during this period, most probably more than the apparent increase), was derived from springs due to the large proportion of the rainfall absorbed by the heavy sand in the catchment.

"To prevent a mistaken inference being drawn however, I may add that the total flow from the Bir catchment is very little. Although the falls just mentioned were 2·55 inches on the 23rd and 4·83 inches on the 24th, followed by ·42 inch up to 8 A.M. of the 25th,—a total of 7·80 inches in 2½ days,—the proportion of the rainfall which was collected by the 25th was ·202 only, and ·074 more was collected through the springs in the 35 days following, making a total of ·276 only. In the Bulad catchment, where there are no similar springs, the soil being less retentive and the water flowing off more freely, double this proportion ran off and was collected on the same occasion. The proportion for the whole season was ·097 at Bir and ·161 at Bulad, and a similar difference has been found in other years, although the rainfall is nearly the same in both localities. It is thus clear that the existence of a retentive soil in the catchment on the whole diminishes the supply of a tank, notwithstanding the partial compensation afforded by springs."

The causes which give a larger proportion of the rainfall to some tanks than to others seem to require further enquiry, and many local circumstances will have to be considered before an attempt can be made fully to explain the difference. But whatever these causes may be, two important facts have been established :—*first*, that the tanks only fill after a heavy fall of rain, and are not affected to any considerable extent by light showers; and *secondly*, that one-sixth only on an average of the annual rainfall reaches the tanks.

Loss by evaporation.

70. The rain which falls upon the catchment area divides itself into three unequal portions.

The largest portion evaporates, while smaller quantities flow off on the surface, and a third portion sinks into the subsoil, re-appearing at a lower level in springs and streams. In a well stocked forest, a fourth portion must be considered, *viz.*, the water which is retained by the branches and foliage. This portion, however, may, in the case of the hills of these districts, be left out of consideration. As far as the tanks are concerned, they only benefit by the surface flow and by the yield of springs and streams. The water which evaporates is lost to them. Now, it must be remembered that the air is, as a rule, exceedingly dry in these districts, even during the monsoon; further that the bare ground on these hills at that time of the year is exceedingly hot and dry. When rain falls upon this heated surface, a considerable quantity of the water is evaporated at once, and a further large quantity is absorbed by the surface soil, most of which is eventually lost by evaporation during the intervals of heat between the showers. In this manner all the benefit of light showers is lost. A heavy downpour, on the other hand, at once saturates the surface soil with water, and after this has been accomplished, the surface flow increases and the tanks are filled.

Evaporation less from a surface clothed with brushwood and forest.

71. Now the effect of clothing the catchment area of these tanks with trees, grass, and brushwood, will certainly be to diminish evaporation, and thus to increase the amount available for the tanks. We may conclude from Mr. Culcheth's experiments that the quantity now lost by evaporation amounts to five-sixths on an average of the rain-water which falls upon the catchment area, but with diminished evaporation the flow into the tanks from a wooded area will be much greater than from a bare surface. To recapitulate, it may reasonably be expected that the protection of the catchment areas will tend to increase the supply of water in tanks by diminishing the loss that now takes place by evaporation from the catchment area itself, when the water soaks in a few inches only, except after very heavy rain, and is then evaporated as soon as the sun comes out. This is repeated many times during the season, and but little water comparatively comes into the tanks, except after heavy rain, when there is a great rush, which is continuous enough to do more than to saturate the surface soil.

72. But the clothing of the catchment area will have another advantage. At present the tanks are generally only filled once or twice during the rainy season, and on these occasions some of the water is often lost by overflow. The increase of forest growth will certainly have the effect of retarding the surface flow, the tanks will be filled more gradually, and the flow will continue for some time after the rains have ceased. The account given by Mr. Culcheth of the continued flow into the Bir tank and the continued rise of its level for 35 days after a heavy fall of rain in September 1875, shows that under certain circumstances the flow of water into the tanks continues for a considerable time after the rain has ceased. In the case of the Bir tank the long continued flow is chiefly attributed to the character of the soil, but increased forest growth will doubtless have a similar effect; it will tend to prolong the flow of water into the tanks, and will thus assist in utilizing it more completely.

Surface flow retarded by a covering of brushwood and forest.

73. Lastly, the quantity of silt brought down by heavy falls of rain will be diminished by better forest growth on these hills. One of the most striking features in Merwara is the large number of the smaller tanks which have completely silted up, often to the edge of the embankment. Many of these silted up tanks have now been converted into fertile fields, the rich silt forming excellent soil, but it was hardly intended, when building embankments, some of which have cost several thousand rupees, to form a few acres of fertile fields.

Less silt will be brought down.

Indeed, it may be said that of the numerous tanks constructed by Colonel Dixon, the great ruler and benefactor of Ajmere and Merwara, many have now become useless, either through silting up or because their bunds were breached, and the ultimate cause of this has been the denudation of the hills which form the catchment area of these tanks.

In the case of the larger tanks the process of silting up is reported to progress very slowly, but whatever the rate of progress of the silting up may be, every ton of silt deposited in these tanks is an unmixed evil, which should as much as possible be guarded against. Even if the whole catchment areas of these tanks were perfectly stocked with forest, the floods caused by the heavy rains would always bring down a certain quantity of silt, but this quantity is much larger when the catchment area is bare and naked.

74. Some of the larger tanks have cost very large sums of money; thus the capital outlay on the Bulad tank was Rs. 95,003, on the Bir tank Rs. 2,16,383, and there are some which have cost even more. It is necessary to utilize this large capital outlay to the utmost, and I would submit that every effort should be made to bring as large a proportion as possible of the catchment area of all existing tanks under protection, and not to construct any new tanks, unless arrangements have previously been made to demarcate and to protect the greater part of the area whence they derive their water-supply.

A larger proportion of the catchment area of tanks should be brought under protection.

The existing reserves comprise portions only of the catchment basin of several tanks, and in no case has the catchment basin of any of the larger tanks been completely protected. As already mentioned, the Srinagar and Bir tract comprises a portion of the catchment area of the Bir tank; and a few others, *viz.*, the Srinagar, Ladpura, and Mahmuni tanks, receive a small portion of their water-supply from that reserve. The demarcation of the area which feeds the Danta tank that is to supply Nusseerabad with water, has, I understand, already been decided upon. The Rajausi tract comprises a small portion of the catchment area of the tank of that name. The Anasagar receives part of its water-supply from the Mohwa Bir and Nagpahar reserves, but the greater portion of its catchment area is unprotected In Merwara, the Sheopura tract in Saroth benefits a number of smaller tanks, and the head waters of some of the streams which feed the Jawaja tank are in the Biliawas reserve.

75. Clearly, the first step in the direction here indicated will be to arrange for the complete protection of the catchment basin of a few of the larger tanks, and to watch the effect of this measure. Under existing circumstances the advantages expected from an improved forest growth for the feeding of the tanks cannot be proved by actual experiment, but in a matter of such importance no time should be lost in making this experiment.

The catchment area of a few tanks should be completely protected.

I would suggest that arrangements be made at once for placing under protection the remaining portion of the catchment area of the Bir tank. In Merwara it may possibly be found advisable to demarcate the hills which furnish the water supply to the Jawaja tank. I understand that a project is under considera-

tion, in order more fully to utilize the water-supply of this beautiful sheet of water. I would also suggest for consideration whether efforts could not be made to place additional areas under protection on the hills which are drained by the Ajapal nala and other streams that feed the Anasagar lake.

No definite results can be expected from partial protection, but if the present suggestions are accepted, and if the whole catchment basin of three or four of the larger tanks is completely protected, or if at least the greater portion of such catchment areas is protected, then the experience regarding the working of these tanks will after a series of years doubtless be so favourable that efforts will be made to extend the present system of reserves upon a very much larger scale.

CHAPTER IV.

DETAILED ACCOUNT OF THE RESERVES.

Ajmere District.

Taragarh reserve.

76. The Taragarh reserve forms a narrow strip, 5 miles long and on an average half a mile broad, and comprises a series of valleys situated between the two parallel ridges which constitute the Taragarh range, south-west of Ajmere. These valleys have two outlets through the ridge on the south-east side, the Nulchasma and the Barinal.

The reserve is naturally divided into three distinct valleys, each of which may be considered as forming a separate block. Each valley or block, moreover, is divided into two nearly equal portions by the stream, one of them having a north-easterly and the other a south-westerly aspect. The blocks may be designated as follows, proceeding from the Fort gate in a south-westerly direction :—

Nulchasma Valley.
Barinal Valley.
Imli Kund Valley.

This Taragarh reserve has been protected since 1872, but its boundaries were not finally fixed, and it was not demarcated until 1874. The demarcation is now complete, and the area is 1,016 acres. The boundary lines are natural ones, generally running along the ridges of the hills. In exposed places, chiefly at the openings of the valley, stone walls, aggregating 16 chains in length, have been built. The lines are indicated by pillars of masonry, which are square, 3 feet high, and have numbers painted on them. The whole area has been protected from fire since 1872, with the exception of Imli Kund, which was burnt in 1874.

The Nulchasma stream contains running water outside the reserve. There are two wells which contain water during the dry season, one in the Nulchasma, the other in the Barinal block. Formerly the Barinal stream used also to flow, but on account of the late drought it is dry at present. In the Imli Kund valley there is now running water. The only tank of importance fed by the streams from this reserve is Bibichilla, but there are wells outside the reserve near the Barinal and Imli Kund streams, from which a considerable area of cultivation is irrigated.

The rock of the Taragarh range of hills is gneiss; it is full of clefts and fissures, and is in most places close to the surface. Only at the bottom of the valleys is there any deep soil, and in the Imli Kund there is a stretch of sand which is supposed to have been blown over a gap in the hill up the valley from the westward.

Right of certain villages to cut grass.

77. Before the revenue settlement was made, a number of villages had the right of grazing cattle in this reserve. At the time of settlement this right was commuted, and in lieu of it the right of cutting grass during a certain time of the year was given to the inhabitants of the following places :—(1) Indarkot (which is a suburb, or rather the upper part of the town of Ajmere); (2) Kasba of Ajmere; (3) Boraj; (4) Kazipura; (5) Taragarh.

This right is permitted to be exercised for six weeks in autumn, and under the terms of this settlement, Government retains the right of closing portions of the reserve against the cutting of grass. The right of cutting grass extends

over the whole tract, but the people of Indarkot have the exclusive right of cutting during the first four days after the forest is opened for cutting.

Private property within the reserve.

78. A portion of the mango garden and some scattered trees in the Nulchasma belong to private persons, as do also two trees in Barinal. There are also two grants of land in the Nulchasma (made by Colonel Dixon), which measure respectively 22 and 13 bighas. The boundaries of these grants have been defined by lines of boundary pillars, and the grass and wood on them belong to the proprietors. There are no other private rights in the reserve.

Natural vegetation.

79. The natural vegetation in this reserve before protection commenced was very scanty and consisted chiefly of "thor" with a few scattered shrubs, of which the following are the most conspicuous:—Ber (*Zizyphus nummularia*), Kumta (*Acacia rupestris*), Khakra (*Butea frondosa*) in the Imli Kund, a little Dhaukra (*Anogeissus pendula*), and some scattered clumps of stunted bamboos on the northern slopes of the hills.

Effects of protection.

80. Protection has had a beneficial effect in increasing the growth of all these trees, and in addition to them the following kinds, which existed formerly, but were not readily noticed, being constantly browsed down by cattle, are now conspicuous, *viz.*, Saler (*Boswellia thurifera*), particularly near the ridges; Dhaukra (*Anogeissus pendula*), covering considerable areas on some of the more gentle slopes, chiefly on those with a south-east aspect; Kalia (*Albizzia odoratissima*); four species of *Grewia*, *populifolia*, *pilosa*, *salvifolia*, and *villosa*; Arinj (*Acacia leucophlæa*). Very marked has also been the spread of bamboos, which now cover considerable areas in the Imli Kund and in the southern part of Barinal. The stems have attained a height of 10 to 15 feet, and though the color of the foliage is pale and yellowish, and though in almost every clump a number of dead stems were observed, still they are spreading, and will probably in a few years furnish marketable material. The Chachra or Khakra (*Butea frondosa*) trees in Imli Kund have attained a height of 10 to 20 feet, and the terminal shoots of last year were from 3 to 4 feet long. Thickets of Dhaukra cover a considerable extent of gentle slopes with fair soil near the bottom of all valleys, but chiefly on southern slopes. Numerous specimens of the Arinj have grown into small trees, 15 feet high, and dense brushwood often covers large areas. Upon the whole, however, it must be said that the progress which the growth of vegetation, particularly in the upper part of the Taragarh valley, near the foot, has made, has been very slow, and has been less marked than in any of the other reserves. This is chiefly due to the absence of seed-bearing trees, and to the annual cutting of grass, which retards the growth of seedlings and the development of coppice shoots. The grass in these areas serves as a protection against frost and the dry heat of the hot weather; and, moreover, with it shoots of many young trees are cut.

Sowing operations.

81. On the neck between the Barinal and Imli Kund valleys about 20 acres of gentle slope were sown broadcast by Mr. McA.Moir in 1874, and the grass on this plot was preserved. The result has been very marked, numerous seedlings of Saler, Kalia, and Khakra standing among the grass 12 inches high. In this place the grass had been cut in 1877, and part of it in 1878, but the plot should now be closed and no grass should be cut in it until the trees have grown up sufficiently to be safe. In another place, also in the Imli Kund, Mr. McA. Moir made sowings on the sides of shallow ditches dug in horizontal lines along the face of the hill. The soil here is a deep sandy loam. A large number of Khair, Jhinja (*Bauhinia racemosa*), Ber, and Khakra have come up, the best plants being on the earth thrown up on the lower edge of the ditch. In this place no grass has ever been cut. In other localities, where the grass has been cut annually, sowings were made in pits dug up with the hand-spade (kurpa) in sheltered places, and by ploughing and broadcast sowing; but wherever the cutting of grass was permitted, no result remains, and it is quite evident that no money should be expended on sowing or planting in this reserve unless the locality can be closed against the cutting of grass.

Pruning.

82. In the Nulchasma block extensive pruning operations were carried on chiefly in 1877. The lateral branches of trees of all sorts were cut and the Ber shrubs were thinned out. A portion of the branches has been left lying on the ground, and I understand that no revenue was made by this operation. Pruning here is entirely out of place. The object of protecting these reserves is to cover the bare rocky slopes as rapidly as possible, and this object

is defeated by the removal of the side branches. Pruning under skilful supervision is under certain circumstances found useful in improving the shape of oak and other valuable timber trees; but, as a rule, it must be regarded as an exceptional operation which requires most skilful supervision. It should on no account be again attempted in any of these reserves.

Planting of trees in the valleys.

83. The only trees and large shrubs of natural growth in the reserve which bear seed regularly are Kumta, Arinj, Ber, and Dhaukra. The number of seed-bearing trees will, however, be considerably increased when the plantations which have been made at the bottom of these valleys have attained a sufficient size. These plantations, though somewhat expensive, have been very successful. They are chiefly at the bottom of the Barinal valley, and consist of Sissoo planted out in 1873 and 1874 from nurseries. These trees have attained an average height of about 20 feet and a girth of 12 to 19 inches.

A number of Siris (*Albizzia speciosa*) trees were also planted. Those of 1873 and 1874 are on an average 15 feet high, and 8 to 13 inches in girth. In addition to these, Siris was sown in carefully-prepared pits. These trees thus raised were watered all the year round except during the rainy season for the first two or three years; afterwards they were occasionally watered during the hot weather only, and watering has now ceased. At the bottom of the Barinal an old field was ploughed up and sown broadcast with Bábul. These trees were not watered at all, and have attained an average height of 20 feet and an average girth of 8 to 15 inches. In addition to these a large number of Mango, Jaman, and Mohwa trees were planted in small stone enclosures and watered regularly every year.

Useful trees to plant.

84. The kinds of trees which are most likely to help on the stocking of this reserve by self-sown seed would be Sáler (the seed of which is light), Kala Siris (*Albizzia odoratissima*), Bábul and Khair. The seed of the three latter kinds would be spread by the agency of birds. Sissoo and the white Siris (*Albizzia speciosa*), though very useful at the bottom of the valley, are not likely to thrive on the stony slopes; otherwise the plan which has here been followed of sowing and planting near the bottom of the valley is of course the correct one. The spread of the seed cannot, it is true, in that case be facilitated by the action of water, but wind and birds will help to spread it upwards over the slopes; under all circumstances planting and sowing should be commenced in those places where success is most likely to be attained, and this with few exceptions will always be on the good soil near the bottom of the valleys. Sowings will, however, probably also succeed on average ground in most parts of this reserve if no grass is cut for a number of years.

Plan of operations recommended

85. I propose that at present the following plan should be followed: The operations should be confined to lines laid more or less horizontally along the lower slopes. The distance between these lines should be not less than 30 feet, and each line should be prepared in the following manner:—

In all suitable places, under the shelter of a stone, rock, tree, or shrub, small cavities should be dug out, the earth being thrown up along the lower edge. The depth of these cavities may be from 6 to 12 inches, and the diameter should vary according to circumstances; but it should not exceed 2 feet. The seed should be sown in these cavities, the bottom of which should be slightly loosened by means of a pickaxe, and some seed should also be sown on the earth thrown up on the lower edge. No hard and fast rule can be laid down regarding the distance between these plots or the quantity of seed to be sown in each. Experience has shewn that in such operations the seed should be sown at the beginning of the rains, which generally commence in July. The grass should be left standing in a belt 6 feet wide along the lines, and at the outset it may be more convenient to prohibit the cutting of grass over the whole area operated upon, permission being afterwards given to cut it between the lines. The most convenient place for these experiments is the Imli Kund valley, since it is at a greater distance than the other blocks from the villages entitled to cut grass.

Whenever money is available, an area of say 10 acres a year should be taken in hand, and the operation should be continued along the lower slopes of this valley. In addition to the trees previously recommended to be sown in these experimental operations, *Ailanthus excelsa* may be sown wherever there are

accumulations of sand. I do not recommend the continuance of planting operations which necessitate watering, and which therefore are necessarily expensive.

86. The Nagpahar range, which separates the valley of the Ajapal river from the drainage basin of the Pohkar Lake, like all other ranges in these districts, runs in a north-east south-westerly direction, and the reserve occupies both slopes of the range. Its length at present is about 4 miles and its breadth about 1 mile. The northern end of the hill is excluded from the reserve, as it belongs to the Dudadari estate. On this estate the forest has been preserved for a long time, and consists now of a variety of trees averaging in height from 20 to 40 feet. The boundaries of the Nagpahar reserve are completely demarcated, and consist, for a length of about 4 miles, of a fence of "thor" with some dry stone walls and pillars in certain places. The boundary marks consist of stone slabs bedded in rubble masonry, and the area is 2,660 acres. **Nagpahar.**

The highest point within the reserve is 2,760 feet. The rock is gneiss, the strike of the strata, as in all hill ranges near, being north-east and south-west, the dip being to the north-west. The consequence of this stratification is that the face towards Ajmere is precipitous, consisting of the heads of the strata, while the slope towards Pohkar is more gentle.

A line of perennial springs is found on the lower part of the slope facing Pohkar, and there is also a spring on the side facing Ajmere. Part of the streams issuing from the Nagpahar reserve serve to fill the Pohkar lake; the others are feeders of the Ajapal nála, which flows into the Anasagar lake.

The rock is close to the surface, and the soil resembles that found in the Taragarh reserve. I examined this hill in December 1869, and the improvement of the forest, especially on the lower slopes towards Pohkar, is much more marked than in the Taragarh reserve, which I visited at the same time.

87. The natural growth on this hill consists of the following trees and shrubs, *viz.*,— **Natural growth.**

Sáler, Dhaukra, Kumta, Khair or Kari Dásan (*Rhus mysorensis*), five species of *Grewia—pilosa, salvifolia, populifolia, asiatica*, and *vestita*, Gol (*Odina Wodier*), Kália (*Albizzia odoratissima*), Kirni (*Wrightia tomentosa*), Karr (*Sterculia urens*), Umbi (*Saccopetalum tomentosum*), Jhinja (*Bauhinia racemosa*), and near the base of the hill Arinj (*Acacia leucophlœa*), and Khejra (*Prosopis spicigera*).

The more gentle portions of the north-western slope are now clothed with a mass of Dhaukra, which has in places attained a height of 10 to 15 feet, and which is mixed with a few other kinds. A considerable number of Kála Siris are found in the ravines. This tree forms a characteristic feature in this forest, and will doubtless some day yield small building timber. Near the top of the hill Sáler is common, but on the ridge the trees are stunted, probably from the action of the wind. At the heads of the ravines on the north face of the hill a large quantity of naturally grown bamboo is found, some clumps of which have now attained more than 20 feet in height.

88. The grass in this reserve is entirely at the disposal of Government, the proceeds being credited to the local or "Nazul" fund. There is only one exception, *viz.*, a small corner taken up from the Dudadári estate, in which the proprietor exercises the right of cutting the grass, and I understood that a suit was pending on appeal at the time of my visit regarding the grass in another portion of the forest. During the last four years the sale of grass has realised the following sums :— **Grass, the property of Government.**

	Rs.
1875-76	825
1876-77	585
1877-78	1,500
1878-79	480

The largest income was realised after the very dry summer of 1877. The sales are held in September, and the cutting extends over the whole dry season.

89. Attempts to improve the reserve have been made near the top of the ridge. At the heads of a number of ravines, Mango, Jáman, and Sissoo were planted in stone enclosures during 1873. They have been watered ever since, **Works of improvement executed.**

and are now 3 to 5 feet high, but a considerable portion has died. A few teak trees were also planted under the shelter of bamboos, and some of them are still alive. A Sissoo tree near the forest hut on the top of the hill has attained a height of 20 feet. The water for these trees was brought up from the spring near the base of the hill, and in order to obtain a supply of water on the spot a number of bunds were thrown across the heads of the ravines. But the catchment area being small, they have not filled; moreover what water remains sinks through the crevices of the rock and disappears. An old bund across one of these ravines ascribed to Ajapál was repaired, and in the hollow behind it a number of bamboos were planted, and are doing well, being now about 15 feet high. In this place it might be useful to sow the seed of *Ailanthus excelsa*, which would probably thrive in the sandy soil.

About 40,000 pits were prepared all along the crest of the hill and seed was sown in them, but there is no result. For several years in succession the grass round these pits was left standing during part of the year, till the young plants died. It is not proposed to resume these operations near the top of the hill, which is exceedingly dry, and where, owing to the high wind, evaporation is very rapid.

Near the base of the hill, on the Pohkar side, mangoes were planted in 1873, and are now from 8 to 10 feet high. They have been watered every year, and protected from frost by means of grass coverings.

Felling of Dhaukra recommended

90. As an experiment, a limited quantity of fuel should be cut near the base of the hill on the Pohkar side during the next three years. For this purpose it will be convenient to roughly divide that side of the hill into compartments, and take up one compartment at a time.

It is believed that the Dhaukra coppices well, and I recommend that in one compartment near the base of the hill, a quantity not exceeding 1,000 maunds annually be cut departmentally and the produce sold. The cutting should be limited to the lower parts of the ravines and valleys, and nothing but Dhaukra should be cut. The cuts should be made close to the ground, and should be made smooth and slanting in all directions.

It is not known at what time of the year Dhaukra should be cut in order to coppice most vigorously. At first the fellings should be made in the hot season, and if this gives no satisfactory result, the experiment should be modified. The areas in which the fellings take place must be closed against the cutting of grass for a number of years. This operation will be a very delicate one, and much mischief may result if it is not carefully arranged and supervised; therefore, it should only be undertaken in the event of competent professional supervision being available for the purpose. There will be no harm in delaying this operation for a time, but eventually it will have to be undertaken and the result carefully watched. The present cost of fuel at Ajmere is said to be between one and two maunds per rupee, so that the operation proposed would result in a small increase of revenue.

Mohwa Bir and Madar

91. The Mohwa Bir and Madar reserves occupy the hills to the east and north-east of Ajmere. The southern end of these hills below the Madar temple is full of quarries, and was excluded from the reserve in 1876. The present area is 2,812 acres. The boundaries are all demarcated by "thor" fences, and by stone slab pillars with engraved numbers. One valley in Mohwa Bir is an enclosure called Mendikola, the property of private persons, and a long valley in the central part (Nazir Alli-ki-nal) is also private property. The ground is exceedingly rocky. The rock is close under the surface and contains a large proportion of quartz, and therefore the soil is poorer than in the other reserves. The greater part of the northern portion, called Mohwa Bir, and measuring 600 acres, has been protected since 1872, while the Madar portion has only been under protection since 1875.

Grass

92. The grass of Mohwa Bir is sold annually for the benefit of the "Nazul" fund, while in Madar the surrounding villages, including the town of Ajmere, exercise the right to cut grass. During the last four years the sale of grass has realised the following amounts :—

	Rs.
1875-76	340
1876-77	350
1877-78	280
1878-79	350

1877 was a very dry year, and the whole of the grass was not sold, but part of it was used for Government.

93. On the tops of the ridges there are numerous Saler trees, but otherwise the forest growth is poor and scanty. The vegetation on Mohwa Bir is similar to that on Nagpahar, but the improvement in the older protected portions is much more marked. There are considerable areas covered with Dhaukra, and the Nim tree is plentiful, growing chiefly in the middle of "thor" bushes. There is also a quantity of self-sewn Babul, and a large quantity of Arinj. Of other trees Gugal (*Balsamodendron Mukul*) and Karil (*Capparis aphylla*) are characteristic. **Natural vegetation**

94. The following work has been done in this reserve by way of cultivation. To the west of the Lohagal road on an extensive flat nearest the Anasagar, about 30,000 pits were dug and sown in 1872-73-74 without any success. In this place seeds of Nim and other trees were dibbled in under the shelter of the "thor" bushes. Further north, on the same side of the road, a considerable area was ploughed and sown broadcast chiefly with babul, which has come up well, the dominant trees being on an average 12 to 15 feet high, with a girth of 7 to 11 inches. A small bund has here been thrown across the Mendikola ravine, the working of which might be improved by the construction immediately above it of a number of slanting spurs to retain the silt which comes down in large quantities, and will continue to do so until the forest has grown up. Along the nala, which passes the Mohwa bagh, a large number of trees, chiefly Nim, *Millingtonia*, *Pongamia glabra*, Persian Lilac and Sissoo have been planted and watered regularly and protected from the frost. These trees were planted in 1872-73 and are doing well. **Works of improvement executed.**

95. No cultural operations are recommended to be undertaken in this reserve at present. It will improve slowly and steadily. It would be a great advantage if in that portion of the Mohwa Bir where the babul sowings have been made the grass could be allowed to remain some years. **No cultural operations recommended**

96. The following are the more important tanks which are fed by streams flowing from this reserve:— **Tanks.**

(1) Anasagar, (2) Nanakia, (3) Lohagal, (4) Chaurasiawas, (5) Bisla (east of Ajmere), (6) Gugra, (7) Rasulpura.

97. The Srinagar reserve comprises a portion of the range east of Ajmere, which separates the Barla valley from the open plain of Nusseerabad. These hills were formerly the grazing grounds of several large villages in their vicinity, of which Barla, Srinagar, and Bir were the principal. The north-eastern corner of the hills has been left entirely open for the cattle of Srinagar, and in addition to this a piece of the reserve south of the Ajmere and Srinagar road is left open for grazing during the period from November to June, goats, sheep, and camels being excluded. In the remainder of the reserve the grass is cut by the inhabitants of the villages formerly entitled to grazing. A fence of "thor" bushes with stone walls in some places has been erected round the greater part of the tract, a short length remaining to be completed. The boundary marks are stone slabs with numbers engraved upon them, and the area is 3,575 acres. **Srinagar.**

98. This reserve has been protected since 1874. When protection commenced these hills were extremely bare, there being nothing upon them but a few "thor" bushes. Shrubs, however, are now springing up, chiefly under shelter of the "thor" bushes. A great difference is at once apparent between the portion which is grazed over and that from which the grass is merely cut. Along several ravines in this reserve a number of Mango, Jaman, and Mohwa trees have been planted in stone enclosures and regularly watered. This was done in 1876. The trees are coming on well and are now 3 to 4 feet high. Seed has also been sown under "thor" bushes, and I saw some Nim trees which are supposed to be the result of this sowing. Nothing but strict protection is recommended for this reserve, but it is essential that an attempt should now be made so to modify the boundary as to get rid of the grazing in the portion nearest Srinagar. **Effect of protection and works of improvement.**

99. The new tank constructed at the foot of the hills above the village of Bir is fed partly by the streams which issue from this range of hills. Other smaller tanks are also fed by them. The Bir tank has cost over two lakhs of rupees, and is expected to irrigate an area of 600 acres. This tank is chiefly fed **Tanks.**

by two streams which run through the whole length of the protected portion of the hills, and by a third stream which rises in hills not protected. The two streams in the protected portion have running water throughout the year, and the source of supply, though not as yet very considerable, will doubtless increase when the area drained by them becomes completely covered with forest growth.

Merwara District.

Dilwara and Chang.

100. The area of the Dilwara and Chang Birs is 235 acres. The boundaries are demarcated by stone slabs bearing serial numbers cut into them. Thor bush hedges and shallow ditches have been made between the boundary marks.

Dilwara Bir is about a mile north-east of Beawar; its shape is very irregular, and it is surrounded by cultivation. Over the greater part of the land the gneiss rock is close to the surface, but there are a few patches of good soil. Two wells were constructed by the late Colonel Dixon, as well as several small bunds, which retain water for a short time. Several ducts from the Bulad tank now pass through the tract. Colonel Dixon planted a large number of Nim (*Melia indica*) and Siris trees, which have attained a height of about 30 feet. There is also some natural growth of Kumta, Khakra, and a few other shrubs.

Works of improvement.

101. In 1874 a commencement was made to sow tree seeds with Kharif crops on all land which admitted of cultivation. The cultivators sowed the seed on condition of their being allowed to cultivate the land without payment. Babul, Khair, Kumta, Siris, Khákra, Jhinja, and Dhaukra were sown in this manner; all except the Dhaukra have come up remarkably well, and it is noticeable that all attempts at cultivating Dhaukra in this district have hitherto failed completely. The plants of the other kinds are from 12 to 24 inches high. Those of the Babul were cut down by the frost several times, but have in most cases sprouted again; and upon the whole, this experiment may be said to have been very successful. In 1876 plants of Siris '*Pongamia*,' Nim, and Ber, brought from the Beawar nursery, were planted out chiefly along the ducts above mentioned, and these operations have been continued regularly ever since. The plants are watered during part of the year, protected from frost by covers of grass, and are doing well. The *Pongamia* requires, as a rule, moist and rich soil, but in this district it is often found to thrive on the road-sides in dry and stony places. Beyond protection and watering of the trees planted, nothing further need be done. No rights of any kind exist in this tract.

Chang.

102. The Chang reserve occupies a portion of the range of hills extending from Chang to Siendra, north of the Beawar-Marwar road. Its length is 4½ miles and its average breadth is one mile. The area is 2,341 acres, excluding a few patches of cultivation, aggregating about 73 acres, enclosed within the demarcated area. The boundary marks are masonry pillars with stone walls, earth embankments, and ditches. The rock, which is gneiss with much quartz, is often close to the surface, and the soil is very dry. In the south-western corner the ground is covered with sand, which has been blown up from a distance. In the centre of the tract is an elevated valley between two ranges of rocky hills, and in this valley is a cave in which a fakir resides. Around his cave the forest has been preserved for many generations past.

Natural growth and recommendation to fell Dhaukra.

103. In the north-eastern portion of the reserve, the hills are fairly stocked with a forest in which Dhaukra is the principal tree, but it is mixed with Kumta, Nim, Kália (*Albizzia odoratissima*) with Kadam (*Nauclea parvifolia*), Babul, and *Cordia Myxa* along the ravines, and with an underwood consisting of Dásan, and two species of *Grewia* (*pilosa* and *populifolia*). The forest in this portion of the reserve is on an average 20 to 25 feet high, and in places is so dense that no grass is found under the trees. The difference between the forest here and that which surrounds the fakir's cave was formerly very marked, but is scarcely visible now.

In this portion experimental fellings of Dhaukra should be made along some of the valleys, so as to test the coppicing power of this tree. The Dhaukra bushes were extremely hacked about in former years, and it is not impossible that if cut back with due care, the shoots might attain the present height of the trees within a few years. The experiment should be made with the Dhaukra

only, none of the other kinds being touched. In the south-western portion, the forest is poorer and more open. It chiefly consists of Kumta, which, under protection, has attained to the size of a small tree, and on the sandy soil, especially near the nálas, there is a considerable quantity of *Acacia Jacquemonti*, a straggling bush with long, thin branches, generally red, otherwise similar to *Acacia arabica*. The forest on the south-east side of the hill is also poor and open.

Works of improvement and effect of protection.

104. In the matter of cultivation of trees the following has been done :— Circular ditches, 12 inches wide and 12 inches deep, with an outer diameter of from four to six feet, were dug with a pit in the centre. The pits were originally intended for the reception of plants. Instead of planting, however, seed was sown on the earth heaped round the pit, and also in the ditches, and in some cases the sowing has been successful. In one place a number of parallel ditches were dug and seed was sown on the earth thrown up, and here a few plants were found. The seeds sown were chiefly Khair, Jhinja, *Pongamia glabra*, and Dhaukra, of which Khair and Jhinja have come up.

A few acres were ploughed and sown broadcast with Babul, and have succeeded well. On low ground a number of trees of Mango, *Pongamia glabra*, and Siris have been planted, watered, and protected, most of which are coming on well. There is a good number of seed-bearing trees on the ground, and the forest is filling up gradually, so that there seems no necessity for further sowing or planting in this tract. The contrast between the protected reserve and the unprotected land around it is very remarkable, as regards the abundance of excellent grass and the good forest growth seen in the former locality.

Tanks

105. Four tanks receive part of their water-supply from this reserve, *viz.*, Ramgarh, Lakhina, Chang, Jagmalpura; and besides these there are numerous wells in the ravines which debouch from the hills. It will be interesting to carry on a regular series of observations to determine whether the further improvement of the forest growth will increase the water-supply in these wells.

Borwar and Kotra

106. The Borwar and Kotra tracts occupy the hills between the villages of Siendra and Kundal. They are separated by the valley through which the old road from Beawar to Marwar passes. The area of these tracts amounts to 3,923 acres. The boundary marks are partly slabs and partly masonry pillars, and in exposed places there are stone walls and fences of "thor" bushes. These hills were demarcated in 1876. They were then almost bare with only a few "thor" bushes and scattered Nim trees. They are now stocked with a dense growth of grass, but otherwise there has not been time for improvement. Numerous small tanks and wells are fed by the streams which issue from these reserves.

Biliawas.

107. The Biliawas reserve occupies a range of hills extending from the Meywar boundary (lands of the Thakur of Bednor) to Taragarh village. The length is about five miles, and the mean width about one mile. The shape of the tract is irregular, and the area, excluding cultivation, is 3,172 acres. The rock is gneiss with a large quantity of felspar, and the soil is good.

Natural forest growth.

108. As regards the forest growth we must distinguish between the spurs and the slopes of the hills, which are chiefly stocked with an open forest of Saler and Gol, with a scanty under-growth of Kumta, and a few other shrubs, and the valleys where the forest is more dense and where Dhaukra is the principal species, often forming thickets of considerable extent, 20 feet high. Khákra or Chachra (*Butea frondosa*) mixed with Babul is found on low ground. I noticed a small number of Khair trees (*Acacia Catechu*) and some Mokha (*Schrebera swietenioides*). Khair was formerly more common, but has been cut out for charcoal. There is also a good deal of Ber (*Zizyphus nummularia*). In this tract there are three forest chaukies, *viz.*, Uma-ki-baria, Bagrot, and Japha.

Works of improvement.

109. A good deal has been done with success in the way of sowing and planting. I examined the nursery in the valley near Bagrot chauki, which is well kept, and from which numerous Mango, Jaman, and Mohwa trees have been planted out along the valleys and stretches of low ground. I also examined numerous plots which had been ploughed and sown with Til and other crops mixed with Babul and Ber. The trees had come up well, and though the Babul had suffered from frost, it will probably eventually survive.

The abundant supply of excellent grass in this tract is remarkable, but the villagers in the vicinity do not avail themselves much of the permission to cut it.

Grazing within the reserve.

110. Two small hamlets, one of six houses and the other uninhabited, are included within the tract, and besides these hamlets, numerous fields belonging to other villages are scattered over the reserve. A fixed number of cattle belonging to the hamlet which is inhabited are permitted to graze within the reserve. Mr. McA. Moir's Report accompanying the Forest Administration Report for 1876-77 states this number as 14 cows, bullocks, and buffaloes.

Todgarh

111. The Todgarh tract occupies a long strip of hilly country extending for 28 miles along the Marwar boundary. Its width varies from half a mile to three miles. The area is 40,048 acres, excluding all cultivation. The western boundary coincides with that of British territory, with the exception of the valley of the Charpalan river, which contains a number of hamlets, and has been excluded. The boundaries are completely demarcated, in some places by masonry pillars, and in others by stone slabs, all marked with serial numbers. Besides these pillars and slabs, there are in exposed places on the eastern boundary 30,700 feet, or about 5½ miles, of stone walling. These stone walls are very useful, but where the line crosses a stream bed, there is an opening which ought to be closed by a fence of dry thorns every dry season.

This reserve is intersected by a number of valleys which originate from the line of watershed running down the centre of the Merwara district. These valleys traverse the tract in a south-westerly direction, but their course is tortuous, frequently following for some distance the strike of the strata, which is from north-east to south-west. The chief of these valleys is that of the Moria river, which drains the country north of Barakhan. The feeders of these streams run usually parallel with the strike of the strata, that is, from north-east to south-west. Thus we have in this tract a large number of valleys which have usually a gentle slope, and are of considerable width. Instances of valleys of this description may be given, such as the long valley with excellent forest, which runs along the back of the Makarji range, and the two valleys at the foot of Goramji, running north-east and south-west from the neck which joins that peak to the table-land of Merwara. The tract is traversed by numerous paths leading into Marwar, but none of them are used much by Brinjara traders, except the Pipli and Kachbali roads, which join on the Marwar border. These paths generally follow the large transverse valleys, but in a few cases they pass through the longitudinal side valleys desc ribed above, as in the case of the Kachbali road.

The rock is gneiss, but in some parts quartz prevails. Thus Goramji is almost entirely a mass of quartz. The two highest points in the reserve are Goramji, 3,075 feet, and Makarji, the height of which is not recorded in the map, but which is probably only a few hundred feet lower.

Natural forest growth Saler forest

112. As regards vegetation two great classes of forest, which may also be designated as belts or zones, can be distinguished. On the higher ranges, such as Makarji and Goramji, they are clearly marked, and they can be traced more or less distinctly everywhere. The upper zone, which may be called a Sáler forest, is an open forest, consisting, besides Sáler (*Boswellia*), of Gol (*Odina*) and Karr (*Sterculia urens*). At the time of my visit these kinds were all leafless, the Sáler only having some scanty foliage. The bamboo (*Dendrocalamus strictus*) is found almost exclusively in this zone, chiefly near the tops of ridges, where it often forms thickets of considerable extent; but it has been cut so much that no full-sized stems are at present available. These naturally-grown bamboos should be protected until they have grown up sufficiently to be cut and sold. This zone occupies the tops of ridges and the upper slopes throughout, and besides the three chief kinds above enumerated, it contains a variety of shrubs and trees of which the most important are the following:—

Kakeran (*Flacourtia sapida*); Golia Dhau, (*Anogeissus latifolia*); Hingota (*Balanites ægyptiaca*); Kheri (*Dichrostachys cinerea*).

In this description of forest is also found the rose wood of South India (*Dalbergia latifolia*), which here is only a small stunted tree.

113. The second or lower zone may be called a Dhaukra forest. This tree covers extensive areas in this reserve, and the most important of its associates are Kâlia (*Albizzia odoratissima*), which is particularly common and of good growth in ravines and near the bottom of valleys. This Dhaukra forest is found well developed on the lower slopes of the Makarji hill. It fills all the longitudinal valleys near this and the Goramji hill, but it is found on slopes with a moderate gradient throughout the reserve. The banks of streams in valleys of this reserve are fringed with a variety of trees, of which the most important are Keim (*Nauclea parvifolia*); Chirli (*Ulmus integrifolia*); Bahéra (*Terminalia bellerica*); and Jaman (*Eugenia Jambolana*). **Dhaukra forest**

114. Several small villages having an aggregate cultivated area of 258 acres are included in the tract. The inhabitants of these villages are entitled to graze a defined number of cattle within the reserve, the aggregate of which is as follows:— **Grazing within the reserve.**

Buffaloes	204
Cows	284
Bullocks	87

Sheep and goats are not admitted.

The difference in the character of the forest in the vicinity of these villages, where the land is grazed over, and in the portions which are not grazed over, is very marked. Besides these villages there were formerly fifteen cattle stations in this forest, where the cattle of the surrounding villages were kept during the hot weather. These stations, which are called "guárs," have now been abolished, and only the inhabitants of the villages included within the forest are now permitted to graze their cattle in it.

115. Attempts at improving the forest by sowing and planting have been made in many places. I examined numerous localities where the ground had been ploughed and seed, chiefly Khair and Babul, had been sown broad cast. The Babul plants are numerous, though they had in most cases been cut down by frost; there seems good reason to believe that they will eventually survive. Of Khair seed a sufficient quantity had probably not been sown, but the plants which had come up were healthy and promising. In other places the ground was dug up with a "kurpa," or small hand-spade, and the seed sown successfully. I also examined numerous localities in the vicinity of streams, where Mango, Jaman, and other trees had been planted. This work should be continued, but I am of opinion that Khair should be the chief tree sown and planted, the seed being procured from Dehra Dún or elsewhere, if sufficient quantities cannot be collected in Merwara. Planting operations should be principally confined to bamboos, which will pay at an earlier date than anything else. **Works of improvement.**

116. The area proposed to be included in the Dewair reserve is situated in the hills which intervene between the open country of Deogarh and Dewair and the Marwar boundary. The area is about 15,000 acres; the length of the tract is about 10 miles; and its greatest width 3¼ miles. The east side of the hills is drained by the head waters of the Khári nadi, a tributary of the Chambal, but the main portion of the area proposed to be reserved is drained by a number of streams which run westward into tributaries of the Luni river. The largest of these streams are the Dewair nal and its tributary, the Jambori nal. The head waters of these two streams are outside the eastern boundary of the proposed reserve. Most of the other streams which flow westward rise within the tract proposed to be reserved. Two important passes traverse the area, one commencing at Chaplián village, the other the road which follows the Dewair nal. The highest point in the area is probably the top of the hill north-west of Dewair, which overhangs the Jambori nal, with an elevation of 2,595 feet. The high hill north of Baghana is outside the area which it is proposed to reserve. The ground within this tract is broken up by innumerable deep valleys and ravines, many of which had a plentiful supply of water at the time of my visit; some of them, I am informed, have running water throughout the year. The rock is gneiss with a proportion of quartz, and the soil is scanty and very dry. **Proposed new forest at Dewair.**

117. The vegetation is extremely poor, and nowhere is there any extent of well-stocked forest, such as is found in a large portion of the Todgarh tract. **Existing vegetation.**

The ridges and upper parts of slopes are stocked with an open forest of Sáler and Gól, with here and there a small proportion of Karr and a sprinkling of other trees and shrubs, of which three species of *Grewia*, with Khirni *(Wrightia)* and Khér (*Acacia Catechu*) are the most important. Here and there at the head of ravines Kália (*Albizzia odoratissima*) is found, and this tree here as elsewhere forms one of the most promising constituents of the forest. The soap nut (Aritha) and Shisham are not uncommon; and extensive thickets of bamboos are found in places.

The lower parts of the slopes and the bottom of the valleys are here, as in the Todgarh tract, occupied by forests of Dhaukra, either pure or associated with the same trees found with it further north. On sandy soil Kumta grows, and north of the junction of the Jambori and Dewair nals, a large extent is found in which it attains the size of a small tree. The streams are fringed with the Indian elm (Chirli), which is common and attains a large size in the valley of the Dewair nal. With it are associated Keim (*Nauclea parvifolia*), Umbi (*Saccopetalum tomentosum*), and Jáman, of which I saw both the narrow and broad-leaved varieties. On flats in the valleys, Khákra (*Butea frondosa*) is common, and in places covers considerable areas. With it are associated Bábul and (in a valley near Dewair) *Mallotus philippinensis*, which seems to have no certain native name here. It has already been stated that the forest is poor throughout, and the descriptions given of the luxuriant growth in the Dewair nál are due entirely to the large specimens of the trees mentioned which skirt the stream. In Marwar, outside the tract proposed to be reserved, there are numerous valleys well stocked with Dhaukra, which resemble the forest in the valleys near Goramji, and in other parts of the Todgarh tract, but these valleys are not in British territory.

Requirements of the surrounding population.

118. The poor state of the forest here described may be partly due to the scanty and dry soil, but to some extent it is also due to the circumstance that the inhabitants of the villages in the open and well cultivated country around Dewair and Chaplián have from time immemorial grazed their cattle in this forest, and they as well as the inhabitants of Deogarh have obtained their supply of wood and bamboos from it. If it should be decided entirely to close the area selected, its closure would be felt as a hardship not only by the villagers in British territory, but equally and perhaps more so by the inhabitants of Deogarh. The villagers in the adjoining tracts of Marwar probably do not depend much on this area for the supply of their requirements in the matter of forest produce, and when the Ajmere-Ahmedabad Railway is constructed, the fuel and charcoal that may be required may be supplied from the much more extensive forests adjoining it in Marwar. Nevertheless it was doubtless a move in the right direction to demarcate the Dewair tract, and it should be declared a State forest under the Regulation, although it may not be expedient at first to enforce all prohibitions completely.

Cutting of grass.

119. Under the Regulation, the inhabitants of the villages the waste lands of which are taken up to form the new reserve, will have the right to cut grass. The exercise of this right is a matter of great importance to them, as they cut grass for sale at Deogarh as well as for their own use. Under the Regulation there is no objection to such sale; but it will of course rest with the forest officer to prohibit the cutting of grass in any localities which it may be deemed advisable to close altogether.

Cutting of wood.

120. The cutting of such wood as is reasonably necessary for household and agricultural requirements is also permitted under the Regulation, but this permission does not include the cutting of bamboos, which for a time should be completely prohibited. There is at present a considerable consumption of bamboos for roofing and basket-making. The result is that the bamboos are not allowed to attain any great size, and it will be necessary for a time to stop their consumption entirely in order to permit the bamboo clumps to recover.

Grazing.

121. Grazing is not permitted under the Regulation, and no camels, sheep, or goats should be permitted to graze in the proposed reserve; but the grazing of cows, bullocks, and buffaloes may continue on the following conditions :—

1st.—That only the cattle of the villages, portions of the areas of which are included in the reserve, are admitted, and that all other cattle are absolutely excluded.

2nd.—That no fires shall take place, and that on the occurrence of any fire the village area in which it occurs will be closed for twelve months at least.

If the prohibitions of the Regulation are enforced in the restricted manner here suggested, the hardship to the people will scarcely be felt, and should the inhabitants of Deogarh require wood for rafters or other purposes, it may be possible to meet this demand by sales of wood in the southern part of the Todgarh tract near Pipli.

Although it is here proposed to enforce the prohibitions of the Regulation only partially in the first instance, this remark must not be held to apply to the whole tract. A belt running along the Marwar boundary should be closed against all grazing at once, and should be demarcated by a convenient boundary line. With the exception of the Jambori nal, this belt is less resorted to by the cattle of the neighbouring villages than is the eastern part. Grazing should eventually be prohibited in all the remaining portion of the reserve.

Villages from the area of which it is proposed to form the reserve

122. The area proposed to be included in this reserve has been taken from ten villages. For six of these villages an area of waste land exceeding one acre per head of cattle has been left to the inhabitants for grazing purposes, while the four villages,— Gadha Matha, Baghána, Chaplián, Dabjar,—have a less area for grazing left outside the proposed reserve. It is for consideration whether the boundary line selected should not be modified so as to provide a larger area for the grazing of these four villages. Dabjar being situated on the edge of the reserve, may perhaps be excluded, and a further rectification of the boundary may be made in Chaplián, Gadha Matha, and Baghána.

If this is done, no great difficulty will eventually be experienced in closing the entire reserve against grazing. As a matter of fact, a similar course was pursued in the Todgarh and Biliawás tracts when they were first taken up. These reserves when first demarcated were partly open to grazing, but have now been entirely closed to cattle of all villages situated outside.

CHAPTER V.

SELECTION OF ADDITIONAL RESERVES AND GENERAL PROPOSALS.

The extension of the reserves will directly benefit the agricultural population.

123. Leaving entirely out of consideration the question whether forest conservancy in these districts will tend to increase the rainfall, and will otherwise affect the climate, or whether it will materially improve the storage of water in the tanks, the measures initiated will have certain great advantages which cannot be doubted. The chief of these are the increased production of wood, bamboos, and grass, and the increased water-supply in springs and wells. I am of opinion that if the greater part of the extensive waste lands which under the Regulation are at the disposal of Government in these districts could be placed under protection, the result would be highly beneficial, and that in a short time this measure would be felt as a great boon by the agricultural population of the district.

A small commencement in protection has already been made by the people themselves, especially on the barren hills of eastern Merwara, where portions of the village waste land have been formed into grass preserves. In the adjoining native States of Meywar and Kishengurh the forest growth on the hills is more or less protected. In advocating the extension of protection over the greater part of the waste lands in the Government villages of Ajmere and Merwara, I do not propose any novel measure, but I only desire to encourage the development, with the aid and under the control of Government, of a custom which is of very old standing in this part of India; but which, under the operation of the settlement made in 1850, had fallen into abeyance in the districts of Ajmere and Merwara.

Additional reserves wanted in the immediate vicinity of the open and well populated country.

124. The question of extending the protected area is intimately connected with the question of increasing the supply of cattle fodder for the agricultural population. The custom of cutting and stacking grass exists in Ajmere and in the more open and better cultivated portions of Merwara, and what is wanted is to develop this custom, and to induce the people gradually to give up the

present practice of driving the cattle over vast areas of waste lands and hills which produce very little fodder, to feed them more on cut grass, and thus to feed them better, and to collect and utilize their manure more completely than is possible under the system of grazing. I am of opinion that it will be well to undertake the further extension of the reserves more on those hills which are situated in the immediate vicinity of the well cultivated plains and valleys than in the more remote and thinly inhabited portions of the district. Thus I would specially recommend the Kalingjar range, the hills which surround the Jawaja plain, and the hills in the vicinity of the Beawar plain to the attention of those who will be charged with the duty of selecting new reserves. The demarcation of reserves in such places must be carried out with great caution, and must only be taken in hand gradually, suitable blocks of land being in the first instance left open for grazing. But the people will gradually appreciate the advantage of a more plentiful supply of grass, especially in bad years, and they will probably take more readily to the custom of cutting the fodder for their cattle than the inhabitants of the wilder portions of the district. But in order that this plan may succeed, it is essential that every possible facility should be given to the people for the cutting of grass in the reserves, and whenever any villages whose lands have been included do not consume the whole of the grass in these lands, arrangements should be made under which the inhabitants of other villages may be admitted. It will be understood that this only relates to the cutting of grass and not to grazing, which of course cannot at the outset be permitted in the demarcated areas.

Additional areas proposed

125. This suggestion, however, is made more with the view of indicating the general policy which I consider Government should follow in future. At the present time I do not propose any sweeping measures, but would limit my proposals to the hills which surround the Jawaja and Beawar plain, and which have already been mentioned, and to a few additional areas which in my opinion should be taken up as soon as possible. These additional areas are as follows.

Continuation of the Nagpahar tract.

126. The north-east continuation of the Nagpahar range as far as the village of Makarwali, and to it should be added the sandy and uninhabited tract which occupies the eastern half of the valley in which the villages of Budha Pushkar and Hokra are situated. It may, perhaps, be possible to demarcate one-half of the valley, *viz.*, that portion which is between the road leading from Pushkar to Makarwali and the foot of the hills, and which consists of low sand hills which are almost useless in their present condition. The cattle of Hokra and the other villages on the west side of the valley graze here; but the pasture is extremely poor. It may not, perhaps, be possible to close the whole area at once, but the land near the foot of the hills should certainly be demarcated. Protection will do something in this area, but it will not alone be sufficient, and sowing and planting on a large scale must here be attempted. This work should, however, only be undertaken in ravines and in the stretches of moist land between the sand hills. The chief kinds of trees which should be grown in this place are *Ailanthus excelsa*, Baonli (*Acacia Jacquemonti*), Jinja (*Bauhinia racemosa*), and Khejra (*Prosopis spicigera*). Operations should commence near the Pushkar road, and should gradually be extended northwards. When this area has been taken up, the whole of the Nagpahar range will be under protection; for the private lands of the Dudadari, which will then form an enclosure within the area taken up by Government, have for some time past been protected.

Head of the Ajapal valley

127. An attempt should be made to take up the head of the Ajapal valley. Above the village of Karekri there is a small area of well protected sacred forest which would form an enclosure in the reserve. If this could be accomplished, nearly the whole catchment area of the Anasagar lake would be under protection, excepting the north-western slopes of the Taragarh hill, which were left open for grazing under the arrangements made when the Taragarh valleys were closed, and which, it is supposed, must continue open for grazing. It is stated that the depth of the lake at the bund has only diminished by 20 feet during a period of about 700 years; but even assuming this fact to have been established by sufficient evidence, it is obvious that near the bund is the last place where silt would be deposited, and an inspection of the banks near the entrance of the streams which feed the lake shows at a glance that the silting process is progressing at a considerable rate, although the Ajapal stream,

which is the main feeder of the lake, has a long course down a gentle slope, so that most of the silt is deposited on its bank before it reaches the lake.

Under all circumstances, whatever the rate of silting up may be, it is obvious that every possible effort should be made in order to secure as steady a water-supply to the lake as possible. Something has already been done by diverting part of the stream which feeds the Pohkar lake into the Ajapal valley, and the measure now proposed is a further move in the right direction. Great inconvenience has been felt on several occasions through an irregular water-supply to the lake; during the hot season of 1878 the lake was entirely dry, and this was partly due to the insufficient monsoon of 1877. The closing of the additional area now proposed should not be carried out at once, but should be effected gradually, so as to accustom the inhabitants of the villages in the Ajapal valley to graze their cattle on a smaller area, and to supplement the pasture by cut grass brought from the reserve.

Tract between Srinagar and Danta.

128. The demarcation of the Danta tract under the Forest Regulation has, I understand, already been decided upon, in order to secure the water-supply of Nusseerabad from the Danta tank, and after this area has been placed under protection, an effort should be made to demarcate the hills intervening between it and the Srinagar tract. If this can be accomplished, the whole of the catchment area of the Bir tank will be under protection.

Kukra tract.

129. Extending from the road between Taragarh and Jessakhera to Bhim village, on both sides of the line of watershed which here runs through the centre of the Merwara district, is a hilly tract, partly covered with jungle, and which includes the catchment area of numerous fertile valleys in the villages of Kukra, Suliakhera, Selma, and Samapa. After discussing the matter on the spot with the Assistant Commissioner, I have come to the conclusion that this tract should be demarcated under the Regulation, and that its protection would be highly beneficial in increasing the supply of grass and water for these villages. The tract might be joined on to the Biliawás reserve. It would have a length of about 8 miles and an average breadth of about 2 miles; its shape would, however, be very irregular, as it would be necessary to exclude the hills situated in the immediate vicinity of the villages named. Here, as in other parts of Merwara, each village has a large number of outlying hamlets. These and the valleys in which their fields are situated would be enclosed in the reserve, but they should all be separately demarcated, and to each hamlet should be attached a certain area of grass land, which, as a matter of fact, is already protected by the people. This reserve, with the villages in its immediate vicinity, and cultivated valleys enclosed within it, should be regarded as an experiment, in order to ascertain how forest protection can be maintained with the least possible interference with the habits and requirements of the people.

At first it would probably not be advisable to close the whole of the demarcated area against grazing, but as the distance of these hills from the villages is not great, and as the people are already accustomed to feed their cattle on cut grass, they might possibly be induced to rely more on the cutting of grass, the supply of which under protection will be largely increased.

Jawaja.

130. If this experiment succeeds, as it doubtless will, then the hills, the drainage from which feeds the Jawaja tank, and the range which skirts the Beawar road on the east from Jawaja to Bulad, should be taken in hand, and afterwards the hilly tract between the open country near Jawaja and the Marwar boundary, so as to join the Kotra tract to the northern end of the Todgarh reserve.

Bhim tract.

131. On the east side of Merwara a series of high hills extends from the village of Bhim in a north-easterly direction, forming the limit of the hilly country on this side. These hills rise to 2,673 feet. North-east of Amner they are not inhabited, and are very bare, everything except Saler having been cut to make charcoal for Nusseerabad. They form a not very pleasing contrast to the well-wooded and carefully-protected range of Sanr Mata in Deogarh (Meywar) on the other side of the Khári nadi. These hills give rise to a large number of small streams which might become useful in case their catchment area were protected, and an effort should be made to demarcate them from Bhim to the Bednor boundary. If no other object were gained, their protection would

increase the supply of grass available for the numerous villages in British territory outside the hills. The reserve would be about seven miles in length and from half a mile to one mile in breadth.

Dewair tract.

132. The demarcation of the Dewair tract has already been proposed. A detailed description of it will be found in the fourth chapter of this report, and it will suffice here to say that the demarcation made has my general support; but that it will not in my opinion be necessary at the outset to close the whole of the area against grazing. In connection with the demarcation of this reserve, it seems to me desirable to extend the Todgarh tract south of Pipli as far as good forest exists, in order to secure a permanent and conveniently situated source of wood supply for the town of Deogarh and the villages in its vicinity.

Subordinate establishments.

133. The protective establishment actually entertained consists of 5 Jemadars on rates of pay from Rs. 10 to Rs. 13 per mensem, and 32 Forest Guards on rates from Rs. 6 to Rs. 8 per mensem. The total cost is Rs. 280 per mensem. By making a slight reduction, this amount may be made to provide also for the Danta and Dewair tracts, the demarcation of which has already been decided upon, and I would propose the following arrangement:—

	Area in acres.	Foresters.	Forest Guards.	Area per man in acres.
Ajmere.				
Mohwa Bir, Nagpahar, and Taragarh . .	6,488	1	6	927
Srinagar, Danta, and Rajausi . . .	6,079	1	6	868
Merwara.				
Chang, Borwar, Kotra, Dilwara, and Chang Birs.	6,499	1	5	1,083
Hatun, Anspahar, and Biliawas . . .	6,558	1	5	1,093
Todgarh	40,048	1	6	5,721
Dewair (estimated area)	15,000	1	2	5,000
Total . . .	80,672	6	30	

This provides for the Danta tract (area 1,244 acres) and for the proposed Dewair reserve, the area of which is not exactly known, but is estimated at 15,000 acres. It will be observed that the entire area is sub-divided into six ranges, each in charge of a Forester. The latter are at present styled Jemadars, and their pay is less than that usually provided for Foresters, but it may be convenient in the present case to include them in this class. Under Rules VI and VIII of the Bye-Laws made under section 9 of the Ajmere Forest Regulation, Forest officers not below the class of Jemadars have special powers in the matter of confiscating wood-cutting instruments and of arresting persons under certain circumstances, and it may perhaps be found convenient in the rules to substitute the term of Forester for that of Jemadar:—

Forester or Jemadar.

			Rs.	Rs
1 on	Rs. 15	per mensem	15	
1 „	„ 14	„	14	
2 „	„ 12 each	„	24	
2 „	„ 10 each	„	20	
				73

Forest Guards.

8 on	Rs. 8 each	per mensem	64	
10 „	„ 7 each	„	70	
12 „	„ 6 each	„	72	
				206

Total 36 men costing Rs. . 279 per mensem.

Thus without any increase of cost better prospects of promotion may be given to the members of this forest establishment. The office establishment, which is as follows, may remain as at present :—

	Rs
1 Clerk (in the Commissioner's Office)	70
1 Munshi	30
1 Store-keeper	13
2 Chaprasis	12
Total	125 per mensem.

In addition to these men, the pay of whom is charged to "Forests," a munshi on Rs. 20 per mensem is entertained and charged to "Irrigation," under circumstances which will presently be explained.

Controlling establishment.

134. The control of the forests is vested in the Assistant Commissioners of the two districts, and as an experimental measure a subordinate officer under the Assistant Commissioner of each district has been placed in charge of the forests and the assessment of the land irrigated by certain tanks. Anwar Khan, Sub-Assistant Conservator of Forests, is in charge of the tank and forest work in Merwara, while the Superintendent of Irrigation, Chattan Lal, has been placed in charge of tanks and forests in the Ajmere district. Under this arrangement the pay of the latter officer (Rs. 150 per mensem) and that of a munshi on Rs. 20 per mensem, are charged to "Irrigation," while the pay of Anwar Khan and of the remaining establishment is charged to "Forests." This arrangement has the advantage that each Assistant Commissioner has one officer entirely under his orders, whose duties are limited to his district, but it has the disadvantage that one man is required to attend to forest work and to tank-revenue matters, which are totally different in character and which have nothing in common. The aggregate cost of these two officers is Rs. 350 per mensem, and it is doubtful whether for this outlay the services of two separate officers for each district for forest and tank work could be obtained.

The number of tanks to which this arrangement relates is 66 in Ajmere, and the assessed revenue involved is about Rs. 25,000 per annum. In Merwara the number of tanks is 14 and the amount of revenue involved is Rs. 13,000 per annum. The work in connection with the tanks requires that the lands irrigated should be visited twice a year, generally in March and November, before the crops of the rabi and kharif harvest are removed from the ground.

The time of these inspections and the work connected therewith does not necessarily interfere with the work that must be done in the forests, and as a temporary makeshift, the arrangement may perhaps be continued; but it should not be made permanent.

What the Assistant Commissioner requires in the matter of forest administration in his district is an active and reliable man who will exercise an efficient control over the forest establishment, and who can be held responsible for the efficient protection of the forest against fire and other injury. For the present reserves, this duty ought to be well performed by a person of the class of Forest Ranger, who has received a regular professional training and whose services might be had at Rs. 100 per mensem. The difficulty is that good men of this class are as yet rare, and that they cannot generally be spared from the work on which they are now engaged. This difficulty will remain until the arrangements for the Forest School have developed sufficiently to furnish a number of well-trained Forest Rangers. Until this has been accomplished, the present temporary arrangements must probably continue.

Some of the work proposed cannot be carried out by the present establishment

135. A certain amount of work has been proposed in this report which cannot be carried out in a satisfactory manner by the forest establishment at present available in Ajmere and Merwara. The chief work of this description may be classified as follows :—

First.—The cuttings proposed to be made with a view of increasing the revenue and of determining the conditions under which the reproduction of the chief trees which compose these forests can be secured.

Second.—The extension of sowing and planting operations.

Third.—The system of observations proposed to determine the rainfall, the water-level of wells, and the dry weather discharge of springs.

Fourth.—The selection and demarcation of additional reserves.

The greater portion of this work will require the services of forest officers possessing more experience and professional knowledge than is available under existing arrangements.

Proposal to connect the forests in Ajmere and Merwara with the Forest School Circle of the North-Western Provinces.

136. The arrangement under which the Conservator of Forests in the Punjab is authorized to depute Mr. McA. Moir from the Punjab to Ajmere, being of a personal character, can obviously only be of a temporary nature, and the great importance of the efficient management and protection of these reserves demand that their control should be placed on a permanent footing. In order to secure this end, it is suggested that the Conservator of the School Circle in the North-Western Provinces should be constituted the professional adviser in forest matters to the Commissioner of Ajmere. The staff of the Forest School, both in superior and subordinate forest officers, must necessarily be stronger than the staff under other Conservators; and whenever such a course may appear necessary, the Conservator of the School Forests will probably find it practicable to depute one of his junior officers to Ajmere for the work here indicated. The Conservator should be authorized to correspond directly with the Commissioner, and in communication with him to arrange for his periodical visits of inspection and for the deputation, whenever necessary, of an officer of the Forest School staff. The task to be accomplished by forest conservancy in Ajmere possesses a peculiar interest, as it is the first instance in India in which Government has undertaken the formation of forests with the chief object of improving the agriculture of the district. But apart from this the work here proposed to be done is of an exceedingly varied character, and will be most instructive for the officers employed on it, and for the probationers and apprentices who will receive their training at the Forest School.

The scheme here proposed will entail no extra expense, except the travelling allowances of the Conservator and his officers on their visits to Ajmere, and this obviously is a very small matter as compared with the great advantages which it is hoped will be secured thereby.

Estimate of future expenditure.

137. The receipts and charges on account of forest conservancy in Ajmere and Merwara during the seven years from 1872-73 to 1878-79 have been as follows:—

Year.	Receipts.	Charges.		Total Charges.
		A, Conservancy and Works.	B, Establishments.	
	Rs.	Rs.	Rs.	Rs.
1872-73	24	4,878	8,177	13,055
1873-74	508	15,777	8,563	24,340
1874-75	203	17,753	8,813	26,566
1875-76	410	12,963	14,383	27,346
1876-77	905	11,433	11,025	22,458
1877-78	3,002	6,961	7,965	14,926
1878-79	1,241	5,182	8,263	13,445
Total for seven years .	6,293	74,947	67,189	1,42,136

The total net outlay during this period has therefore been Rs. 1,35,843. For the future it will be possible to reduce the charges considerably, and the follow-

ing may be accepted as an estimate of the ordinary annual outlay that will probably be required during the five years commencing with 1880-81:—

A.—Conservancy and Works.

	Rs.
I.—Timber operations on account of Government	1,000
VI.—*a.* and *b.* Feed and keep of cattle	100
c. Plant and Tools	100
VII.—*a.* Roads	500
b. Buildings	200
VIII.—*a.* Demarcation	200
b. Plantations	2,500
c. Fire protection	2,000
f. Fences and other works	1,800
IX.—Miscellaneous	100
Total Conservancy and Works	8,500

B.—Establishments.

	Rs.
I.—*b.* Pay of superior officers	2,400
c. Subordinate forest establishments (279 × 12)	3,348
d. Office establishments	1,500
II.—Travelling allowances, including provision for travelling expenses of officers deputed from other Provinces	1,700
III.—Contingencies	552
Total Establishments	9,500
Add Conservancy and Works	8,500
Total Expenditure	18,000

In explanation of these figures the following remarks are submitted.

The outlay entered under *A I.* provides for the cutting and stackin gof 5,600 maunds of wood for sale, which may be expected to realize about Rs. 1,900.

Under *VIII* (*a*) the cost of erecting 50 pillars a year, which will be required for extensions, and of repairing existing boundary marks is provided.

U ler *VIII* (*c*) Rs. 2,000 is provided for fire protection against Rs. 500, which at present is about the annual outlay under this head. For some time to come the charge under this head will necessarily be heavier than hitherto, the risk from fire being greater now than it was when the protection of these areas was first undertaken.

Under *VIII* (*f*) Rs. 1,800 has been entered in order to provide for the construction of dams, spurs, and embankments across valleys and ravines as suggested in paragraph 19.

The charges under B, "Establishments," are framed in accordance with the existing scale, modified as now proposed. Rs. 1,000 have been added under *II* in order to cover the travelling expenses of any officers who may be deputed from the Forest School Circle for the supervision of work in the reserves and for inspection.

138. No reliable estimate of the revenue can be framed. As stated above, the revenue actually realized during the last seven years has aggregated Rs. 6,293. **Estimate of future receipts.**

The revenue will be increased by the proceeds of the cuttings now proposed, and it is for consideration whether grazing dues should not be paid in those cases in which any portions of the forests are opened to grazing. Rule XII of the Bye-Laws made under section 9 of the Ajmere Forest Regulation provides that passes may be issued by the Forest Officer, stating the number of cattle admitted to graze in a defined area, and during a specified period, and that any cattle found grazing in excess of those specified in the pass shall be charged at punitive rates.

It is for consideration whether this rule may not with advantage be modified, and grazing dues levied on all cattle admitted from villages outside the forest. As the cutting of grass is free under the Regulation, such a payment

would not cause hardship to the people, while, on the other hand, the villagers would be more likely to resort to the cutting of grass if grazing had to be paid for. If grazing dues are levied, as here proposed, buffaloes, bullocks, and cows might be admitted during the hot weather in selected blocks of the forests. Pending a decision on this suggestion, we cannot expect more than Rs. 2,000 as the annual revenue from these forests, which leaves the net annual outlay at Rs. 16,000. On 80,672 acres, the area of the reserves after the Dewair and Danta tracts shall have been added, this amounts to 3⅛ annas per acre per annum. But the reserves yield grass and wood to the villagers without payment, and the local funds realize on an average Rs. 2,000 by the sale of grass and mangoes in the Nagpahar and Mohwa Bir reserves, which amount, strictly speaking, ought to be credited to "Forests." But even if this were done, it will be some time before the receipts are sufficient to cover the charges.

However, what has been stated in this report will suffice to show that the value of these reserves must not be measured by the revenue which they produce, but by the increased production of cattle fodder and wood for the people, and by the effect which their protection will have in increasing the water-supply in wells, tanks, and springs.

APPENDICES.

APPENDIX A.

THE AJMERE FOREST REGULATION, 1871.

A Regulation to provide for the establishment of State Forests in Ajmere and Mhairwarra, and to prevent the indiscriminate felling of trees and removal of jungle in Mhairwarra.

Whereas by a Resolution passed by the Secretary of State in Council on the 16th day of March 1871, the provisions of the 33rd Victoria, Chapter 3, section 1, were declared applicable to Ajmere and Mhairwarra;

And whereas the Chief Commissioner of Ajmere has proposed to the Governor General in Council a draft of the following Regulation, together with the reasons for proposing the same;

Preamble.

And whereas the Governor General in Council has taken such draft and reasons into consideration, and has approved of such draft, and the same has received the Governor General's assent:

In pursuance of the direction contained in the said section, the said Regulation is now published in the *Gazette of India*, and will be published in the local *Gazette*, and will thereupon have the force of law:—

Preliminary.

Short title.

1. This Regulation may be called "The Ajmere Forest Regulation, 1871."

Interpretation-clause.

2. In this Regulation, unless there be something repugnant in the subject or context—

the expression "Villagers" includes the members of the proprietary body of any village; and any other persons or class of persons who may, by a written order of the Commissioner, subject to the control of the Chief Commissioner, be declared entitled to the status of villagers under this Regulation;

the expression "Forest Officer" means any person or persons whom the Chief Commissioner of Ajmere from time to time appoints to exercise the powers and perform the duties hereby conferred and imposed on a Forest Officer;

and the expression "Cattle" includes also elephants, camels, buffaloes, horses, mares, geldings, ponies, colts, fillies, mules, asses, pigs, rams, ewes, sheep, lambs, goats, and kids.

Taking up of land under this Regulation.

Declaration for taking up land.

3. Whenever it appears to the Chief Commissioner of Ajmere expedient that any tract of waste or hilly land comprised in the area of any village should be taken up by the Government for the purposes of a State Forest, a declaration in the form given in Schedule A, hereto annexed, or to the like effect, and describing the land by its boundaries, or otherwise with convenient certainty, shall be published in the local *Gazette*, and a copy of such declaration in Hindi, together with a written explanation in Hindi of the terms as hereinafter laid down on which the land is taken by the Government, shall be delivered to the lumberdars of the village.

Legal effect on such declaration.

4. Such declaration shall be conclusive evidence as to the nature and condition of the land and as to the expediency of taking it up;

and on its publication in the local *Gazette* the following consequences shall ensue:—

(*a*.) The proprietary right to the land shall vest in the Crown, and in lieu of all rights which any person may now have in or to such land, the rights hereinafter in that behalf mentioned shall be reserved to the villagers:

(*b*.) The Forest Officer may enter and take possession:

(*c*.) Subject to the rules and limitations in the next following section provided, the undermentioned rights over the land may be exercised by the villagers, that is to say:

Rights created in favour of villagers.

To cut grass.

(1).—A right to enter upon the land to cut grass thereon;

To cut wood.

(2).—A right to enter upon the land to cut such wood as is reasonably necessary for the household requirements and agricultural implements;

To use ways.

(3).—A right to use all such ways of a defined and permanent character over the land as were in use by them at the time the declaration was published and are still adapted for use.

Villagers' rights to be exercised under control of Forest Officer.

5. The rights vested in the villagers, under section 4, shall be exercised subject to the control of the Forest Officer, who may, from time to time, among other things, and subject to an appeal to the Commissioner of Ajmere—

(*a.*) issue written orders, determining the seasons at which grass may be cut, and the mode of cutting it, and prohibiting the cutting of it in any part of the land where such cutting would tend to damage the trees there growing;

(*b.*) issue written orders determining the season when, and the place where, wood is to be cut;

(*c.*) stop any way across the land, and assign another way instead of it, provided that the new way set out by him be a reasonably convenient substitute for the way so stopped.

6. There shall be distributed among and paid to those who, previous to the taking up of the land, were interested therein, the following proportions of the net profits (if any) from time to time resulting from the State Forest operations on the land, after deducting all expenses of management, namely, of profits from operations other than the working of mines and quarries—two-thirds; of profits from the working of mines and quarries—one-half.

The amount of such profits, the times at which they are payable, the persons entitled to participate in them, the shares claimable by such persons, and the mode of distribution, shall be determined by the said Commissioner, subject to the control of the said Chief Commissioner, by a declaration in writing, and such declaration shall be final and conclusive as against all persons concerned.

Forfeiture of part of profits for misconduct.

7. If the members of any village community, or any other persons entitled to a share of profits under such declaration, have interfered with or obstructed the State Forest operations, or have not rendered such assistance to the Forest Officer as may be lawfully required of them, the said Chief Commissioner may direct that there shall be withheld from them a sum not exceeding one-half of the profits which would otherwise have accrued to them or to the village community of which they are members, and such sum shall be withheld accordingly, and shall be credited to the Forest Department.

No fine to be levied for cattle trespass on unprotected forest.

8. When any land has been taken up for a State Forest under this Regulation, no fine shall be levied in respect of any trespass by cattle thereon until the Forest Officer has efficiently protected that portion in which grazing is prohibited, by fencing or, with the Commissioner's sanction, demarcated it by conspicuous marks, which have been duly notified in the vicinity. But this section shall not apply where cattle have been wilfully caused to trespass by the owner or any person in charge of them.

Power to make rules.

9. The Chief Commissioner of Ajmere may, by a Notification in the local *Gazette*, make rules consistent with this Regulation for the management and protection of State Forests created under the provisions herein contained, and may, by a similar Notification from time to time, alter, add to, or rescind such rules. He may, in making any such rule, attach to the breach of it in addition to any other consequences that would ensue from such breach, a punishment, on conviction before a Magistrate of a fine not exceeding, for the first offence, rupees fifty, and for the second or any subsequent offence, rupees one hundred.

Relinquishment of land taken up under this Regulation.

Declaration for relinquishing land.

10. Whenever it appears to the said Chief Commissioner that a tract of land taken up under this Regulation is no longer required for the purposes of a State Forest, a declaration in the form given in Schedule B, hereto annexed, or to the like effect, and describing the land by its boundaries, or otherwise with convenient certainty, shall be published in the local *Gazette*, and a copy of the same in Hindi shall be delivered to the lumberdars of each village within the area of which any portion of such land was originally included.

Restoration of land disforested.

11. After publishing such declaration, the Commissioner of Ajmere shall, as soon as conveniently may be, proceed to restore the land so disforested to the communities or persons to whom it belonged before it was afforested, so far as the change of circumstances will permit, and subject to such charges for works of permanent improvement effected by the Government as to the said Commissioner seems proper.

For this purpose he shall issue an order in writing, specifying the communities or persons to whom each portion of the disforested land is to be restored, and their interests therein, and the nature and incidence of the charges thereon. Such order shall be binding and conclusive on all parties concerned.

Restriction of the right of felling trees and making charcoal.

Chief Commissioner may make rules.

12. The Chief Commissioner of Ajmere may, by a Notification in the local *Gazette*, make rules for the prevention of charcoal burning and destruction of trees in the vicinity of the State Forests or in other places where these practices may in his opinion be injurious. In issuing such rules due regard will be had to proprietary rights.

Recovery of fines.

Recovery of fines.

13. The provisions of sections 63 to 70, both inclusive, of the Indian Penal Code, and of section 307 of the Code of Criminal Procedure, shall apply to all fines imposed under this Regulation, or under the rules made in the exercise of the power given by section 9 of the same.

SCHEDULE A.

(See Section 3.)

Form of declaration for taking up land.

The waste (or and) hilly land below described being required for the purposes of a State Forest, is hereby under the orders of the Chief Commissioner taken up for such purpose, and the present declaration is made and published under the Ajmere Forest Regulation, 1874, section 3.

SCHEDULE B.

(See Section 10.)

Form of declaration for relinquishing land.

The land below described being no longer required for the purposes of a State Forest, is hereby under the orders of the Chief Commissioner relinquished, and the present declaration is made and published under the Ajmere Forest Regulation, 1874, section 10.

APPENDIX B.

FOREST BYE-LAWS.

Under Section 9 of the Ajmere Forest Regulation, 1874.

Sanctioned by the Chief Commissioner and published in the "Rajpootana Official Gazette" *of the 19th June 1875.*

I. The limits of all State forests shall be indicated by conspicuous boundaries. The pillars shall be erected and maintained by the Forest Department; village boundary pillars falling within the limits of any State forests shall be maintained as formerly by the villagers.

II. Acts prohibited in State forests:

(1). The following acts are prohibited:—

a. Breaking up waste land for cultivation without permission of the Forest officer.
b. Setting fire to grass or negligently permitting fire to extend to a State forest.
c. Setting fire to brushwood, trees, or stumps of trees.
d. Lopping, breaking, or otherwise injuring growing trees or bushes.
e. Removing soil or dead leaves from under trees.
f. Felling standing trees.
g. Cutting young trees under any circumstances.
h. Collecting fallen wood of any kind without permission of the Forest officer.
i. Collecting gums, resins, honey, wax, or other minor forest produce.
j. Carrying or kindling fire.
k. Carrying any implement to cut wood, except when it is carried in pursuance of a permit to cut wood.
l. Digging or quarrying for stones, lime, or kunkur without permit.
m. Grazing cattle without permit.
n. Cutting grass otherwise than is provided for in Section 5 of the Forest Regulation.

(2). Any person who shall commit a breach of this rule shall be punished on conviction before a Magistrate, with a fine not exceeding, for the first offence, Rs. 50, and for the second or any subsequent offence, Rs. 100. This punishment is to be in addition to any other consequences that would ensue from such breach.

III. *Responsibilities of zemindars.*—It shall be the duty of all zemindars, whose habitation is not more than three miles from the State forest to render aid in extinguishing forest fires.

IV. The zemindars of any village within three miles of a State forest are individually and collectively responsible for rendering aid towards preventing or extinguishing fires in a State forest.

V. If any person, whose duty it is under Rules III and IV to render aid in preventing or extinguishing forest fires, refuses or neglects to render reasonable aid on being required to do so by a Forest officer, the person shall be liable on conviction before a Magistrate of the first or second class, to a fine not exceeding for the first offence Rs. 50, and for the second or any subsequent offence Rs. 100.

VI. *Powers of Forest Department.*—Forest officers not below the rank of Jemadar shall have the power to confiscate any wood-cutting instrument carried by any person within these forests, unless it is carried in pursuance of a permit to cut wood.

VII. Any Forest official may arrest any person found in the act of doing the things prohibited in clauses (*b*), (*c*), (*d*), (*g*), (*i*), (*j*) of Rule II.

The person arrested may be made over to the zemindar of his village provided that security to the value of Rs. 100 is given for his appearance.

In default of security he should be conducted without delay before the nearest Magistrate.

VIII. Any Forest officer not below the rank of a Jemadar may arrest any person found in the act of doing any of the things prohibited under Rule II (except under clause *a*) if the arrest of the offender appears necessary to prevent his evasion of the penalty attached to breach of this rule.

IX. All articles confiscated shall be made over for disposal to the Deputy Commissioner.

X. *Cattle trespass.*—All cattle found straying or unlawfully grazing in any State forest may be seized by any Forest official, and when so seized, shall be driven forthwith to the nearest pound.

(*a.*) When a right of way through the State forests is maintained, it shall be held to protect from seizure all cattle lawfully driven along the road or track indicated, even though they stray into the forest, so long as the driver uses reasonable diligence to prevent them from straying, and to drive back such as stray.

XI. *Revenue,* (*a.*)—The revenue from State forests shall be divided in proportion to the area of land belonging to each village in the tract entitled to share under section 6 of the Regulation, and irrespective of where wood or other produce may have been cut or obtained.

(*b.*) The Forest Department shall, from time to time, remit the sums due to the zemindars to the Deputy Commissioner (through the Commissioner), who shall specify the amount due to each village.

XII. Rules for grazing in State forests:

(*a*) The grazing shall be for a defined area and specified period, and under a pass stating the number of cattle admitted to graze.

(*b.*) Application shall be made to the Forest officer by the lumberdar or patail of the village requiring grazing one month before the date required containing a statement of the number of cattle belonging to the village, and the number for which a pass is required. Any cattle found grazing in excess of those specified in the pass shall be charged at such punitive rate as the Chief Commissioner may, from time to time, fix by notification in the Gazette.

(*c.*) The owners of all cultivated land within the boundaries of State forests shall only be entitled to pass into the forests such cattle as are *bonâ fide* required for ploughing or other agricultural purposes.

Grazing for the animals admitted to the forest shall, as far as possible, be allowed within forest limits.

XIII. All fines levied under these rules shall be credited to the Forest Department.

APPENDIX C.

Rainfall registered at Beawar for 23 years, 1856 to 1879, with remarks by Mr. W. Culcheth, Executive Engineer, Irrigation Division, Ajmere, dated 5th September 1879.

Where noted	Year.	Rainfall of each month. Dry Season. April	May	Monsoon. June	July.	August.	September.	Dry Season. October.	November.	December.	January.	February.	March.	Total rainfall of each year.	Rainfall of the various seasons. Dry. April and May.	Monsoon. June to September.	Dry. October to March.
		Inches	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches	Inches.	Inches	Inches	Inches.	Inches	Inches	Inches	Inches.
Beawar Tehseel	1856-57	·1	..	1·7	11·6	5·3	1·2	...	...		2·7	·4	...	23·0	·1	19·8	3·1
	1857-58	·3	·3	7·4	1·2	11·5	5·2	...	...	...	1·0	...	...	26·9	·6	25·3	1·0
	1858-59	.	..		19·5	·3	1·2	...	...	.	·4	.	·6	22·0	...	21·0	1·0
	1859-60	...		2·1	10·6	6·5	3·8	...	...	.	...	·2	...	23·2		23·0	·2
	1860-61	...	1·3	·7	2·8	1·9	·3	...	..	..	...	...	...	7·0	1·3	5·7	...
	1861-62	...	·3	2·3	2·4	14·2	..	..	...	2	...	.	...	19·4	·3	16·9	2
	1862-63	...	...	2·1	23·5	7·3	9·2	·6	...		...	...	...	42·7	...	42·1	·6
	1863-64	...	...	9·5	10·9	2·5	.	...	...	..	..	.		22·9	..	22·9	
	1864-65		...	·3	9·3	10·2	·9	...	...	...	·3	1	2·1	23·2	..	20·7	2·5
	1865-66	1·0	...	·4	2·8	11·1	1·5	...	...	...	...	..	...	16·8	1·0	15·8	...
	1866-67	...	...	1·1	3·8	9·0	..	7	...		..	..	·2	14·8	...	13·9	·9
	1867-68	·2	·5	1·2	4·4	8·0	·8	...	...	1·6	.		·1	16·8	·7	14·4	1·7
	1868-69	·3	·1	4	3·8	8	...	.	...		5	·3	6	6·8	4	5·0	1·4
	1869-70	...	..	..	2·0	2·4	10·7	1·0	...	2	...	...	·7	17·0	...	15·1	1·9
	1870-71	...	...	·8	4·7	5·1	·1	4	...	1·0	...	...	...	12·1	..	10·7	1·4
Executive Engineer's Office	1871-72	·32	·75	8·53	6·94	·85	1·71	...	3·20	·21	..	..	..	22·51	1·07	18·63	3·41
	1872-73	...	30	90	3·70	15·80	49	..	.	..	·10	·20	.	21·49	30	20·89	30
	1873-74	.	1·85	74	18·75	8·16	1·71	..	...	...	·07	05	...	31·23	1·85	29·26	·12
	1874-75	...	·02	1·68	10·74	6·88	1·75	...	...	.	...	2·03	...	22·70	·02	20·65	2·03
	1875-76	...	2·90	1·26	6·04	1·19	16·56	.	..	68		.	...	28·62	2·90	25·04	·68
	1876-77	·09	·62	1·76	7·20	4·69	9·00	·19	·23	.	...	...	...	23·78	71	22·65	42
	1877-78	·60	·18	2·73	8·59	43	41	2·52	1·12	66	...	·09	...	17·28	68	12·21	4·39
	1878-79	...	·28	2·98	4·58	12·64	29	...	...	.	...	1·40	·26	22·43	·28	20·49	1·66
Quinquennial averages	1856—61	·08	·32	2·38	9·14	5·10	2·34	..	...		·82	·12	·12	20·42	·40	18·96	1·06
	1861—66	·20	·06	2·92	9·78	9·06	2·32	·12	...	04	06	·02	42	25·00	26	24·08	66
	1866—71	·10	13	·70	3·74	5·06	2·32	42	..	·56	10	1·06	·32	13·50	·22	11·92	1·46
	1871—76	·06	1·17	2·62	9·23	6·48	4·44	...	64	18	·03	46		25·31	1·23	22·77	1·31
	1876—79	·19	36	2·51	6·79	5·92	3·23	·90	·45	·22	.	50	·09	21·16	55	18·45	2·16
Average of the 23 years		·12	41	2·20	7·82	6·36	2·90	23	·20	20	·22	·21	20	21·07	·53	19·28	1·26
Maximum — Years		1865	1875	1863	1862	1872	1875	1877	1871	1867	1857	1875	1865	1862-63	1875	1862	1877-78
Maximum — Rainfall		1·00	2·90	9·50	23·50	15·90	16·56	2·52	3·20	1·60	2·70	2·03	2·10	42·70	2·90	42·10	4·39
Minimum — Years		Nil.	Nil.	Nil.	1857	1858	Nil.	Nil	Nil.	Nil.	Nil	Nil.	Nil.	1868-69	Nil.	1868	Nil.
Minimum — Rainfall		...	...	...	1·20	1·30	—	...	...	.	..	...	...	6·80	...	5·0	...

Remarks.

The results from 1856 to 1871 are obtained from the observations taken at the Tehseel at Beawar. The original records were examined by me and the results worked out afresh.

From 1871 to 1879, the results are obtained from the observations made at the office and godown of the Irrigation Division at Beawar.

This table shows the average rainfall of the monsoon to be 19·28 inches and that of the dry season 1·79 inches, making a yearly total of 21·07 inches. The heaviest rainfall was 42·70 inches in 1862-63 and the least 6·80 inches in 1868-69. The extremes of the monsoon rainfall occurred in the same years, but most rain in the dry season has been noted in late years, probably owing to more careful observations having been made. The gauges formerly in use were not suited to noting light falls of rain correctly.

The years have been taken as commencing with April, the same as the official year, as more convenient in connection with irrigation in this district; and, moreover, a fresh season as regards the rains appears to begin about that time. December and January are in the middle of the cold weather, when rain is looked for to benefit the rabi crops; the rain may come in either December or January. By commencing with 1st April, the rabi season is over, and any rain falling at that time, which is not often, does not affect the crops in this district.

The fall of the two months of the dry season before the monsoon has more than once seemed to me to affect the character of the monsoon itself, heavy rain in May retarding the rains, the total of these two months has therefore been given separate from the rest of the dry season (see columns 16 and 18).

APPENDIX D.

Abstract of the rainfall registered in the vicinity of Beawar (Merwara) in one week and in the whole month of September in 1875 and again in 1876, noting the relative positions of the stations, with remarks by Mr. W. Culcheth, Executive Engineer, Irrigation Division, Ajmere, dated the 5th September 1879. The results obtained in some other parts of the district also are added in this statement for comparison.

By what Agency noted.	Stations.	1875, September.		1876, September.		Situation of stations with reference to Beawar.	Remarks.
		From 19th to 25th.	Whole month.	From 3rd to 9th.	Whole month.		
Public Works Department.	Beawar Exe. Engr's. Office	10 96	16·36	6·62	9·00	.....	In 1875, the heaviest rain (nearly 16 inches in the week) in the vicinity of Beawar fell about 5 miles to the south of that place, and the lightest (about 10 inches in the week) 4 miles to the south-west, the distance between the extremes being about 4½ miles. In 1876, the heaviest rain in the vicinity of Beawar fell about 6 miles to the south-east and south, and the lightest about 7 miles to the south west, the nearest approach of the two extremes (6 inches and 10½ inches approximately in the week) being only 5 miles.
	Bulad Bungalow	14 35	18·23	9·01	10·47	S. E., 3 miles.	
	Mandoti			10 34	12·05	E., 4 "	
	Barkhala	11·97	16·53	10 41	11 80	S. E., 4½ "	
	Semla	12 20	18·00	..	...	S. E., 4 "	
	Ballan	15 85	20·04	...	...	" 5 "	
	Sheopura	12·49	17·34	.	.	" 6 "	
	Attimund	13 78	19·42	9·53	11·49	S. 5 "	
	Kaliawas and Rampura	15·73	20·24	8·72	9·76	" 4 "	
	Jalea Bungalow	10 19	14 94	7·40	8·99	S. W., 4 "	
	Portabpura	.	...	6·19	7·87	" 4½ "	
	Malipura	...	..	7·51	9·30	" 4 "	
	Bhyasapa	...	..	6·69	8·25	" 6½ "	
	Kali Kankar		...	6 06	7·54	" 6½ "	
	Sendra Bungalow	12·44	17·01	8·29	10 00	W., 9 "	
	Jawaja ditto	18·68	28·02	3·47	4·89	S. W., 14 "	
Civil Department.	Ajmere	11·90	17·90	1·80	3·40	N. E., 31 miles.	In 1875, the lightest rainfall was at Harmara, at the extreme north of the district, and the heaviest at Dewair at the extreme south, 112 miles apart. The heavy rain fell near the main range of hills, generally, decreasing on each side. In 1876, the lightest rain fell at Ajmere and the heaviest at Dewair. The heavy rain fell some distance to the east of the main range of hills except in Southern Merwara, the light rain was on the west side of the district.
	Kamara	5·70	9·80	4 50	6 00	" 55 "	
	Beawar	13 40	16 50	7·00	9 50	.....	
	Masuda	8 50	10 00	5·80	8 50	E. 12 "	
	Dewair	32·00	39·20	10·30	15·10	S. W., 57 "	

APPENDIX E.

Abstract of the rainfall in the vicinity of certain of the large tanks in Ajmere-Merwara compared with the quantity of water collected from the catchment basins, with remarks by Mr. W. Culcheth, Executive Engineer, Irrigation Division, Ajmere, dated the 5th September 1879.

Name of tank.	Years which have been worked out.	No. of years.	Average rainfall of the monsoon.	Depth of water collected if spread over the catchment.	Proportion of the rainfall collected.	Remarks.
			Inches.	Inches.		
Anasagar	1874 to 1876	3	22·03	2 85	·13	1. The results for other years have not yet been worked out completely. 2. Those here given have been obtained as follows :— The water levels have been noted daily and the increase in the supply due to each fall of rain calculated, the areas of the contours having been previously ascertained. The area of the catchment of each tank being also known, the depths given in column 5 have been calculated by dividing the quantity of water collected by the area of catchment. Lastly, the depth found in this way being divided by the rainfall recorded gives the result shown in column 6, which represents the proportion of the rainfall flowing off the catchment.
Bir	1873 to 1876	4	20 50	2·04	·10	
Rajaosi	1875 & 1876	2	20·30	3 61	·18	
Bulad	1875 & 1876	2	25·25	6·98	·28	
Bicharli	1871 to 1876	6	21·65	4·36	·20	
Mean			21·05	3·97	·18	

APPENDIX F.

Memorandum on the probable influence of Forest operations on the tanks in Ajmere and Merwara, by Mr. W. Culcheth, Executive Engineer, Irrigation Division, Ajmere, dated the 30th December 1878.

Those results of forest conservancy in this district which Dr. Brandis alluded to as affecting the tanks, *viz.*, retarding the rush of water and the washing down of silt from the hill sides, and the formation of springs, could be more speedily and surely obtained by the construction of numerous small dams to intercept the drainage. The dams could be formed in

a season or two, and the effects would begin to be seen at once; whereas the forests under ordinary conditions will take years for the trees to reach any size, and a still longer period probably to effect any great change, unless assisted by other agency.

2. Dams of dry stone should be placed at intervals of say 50 to 100 yards across the nalas, rising a few feet above the bed with the ends raised to the level of the banks, or in the case of shallow nalas, somewhat higher than the banks and protected by mounds of earth from being turned by the water; earth should be thrown up against the dry stone on the up-stream side; at suitable sites, where rock might crop up, dams of lime masonry should be formed. Across the steeper slopes, not culturable generally, walls of dry stone with earth thrown up on the upper side should be formed. In the cultivated area, the lower side of each field should have a bank raised sufficiently to retain the largest quantity of rain water likely to collect on it; as the ground became more level these banks would be further apart.

3. The banks on the cultivated land would prevent most of the rain falling on it from flowing off, and would cause a great deal of water to soak into the soil. The walls on the steep slopes, not now culturable, would keep silt from washing down to a lower level, and retarding the flow of water off the surface would allow of much soaking into the ground. The dams across the nalas would lessen the rush of water down them and keep back silt, which as it increased would absorb some of the water. As these dams might silt up, they should from time to time be raised.

4. By these means the subsoil would become saturated and springs formed; the stony, waste slopes of the lower parts of the hills would become covered with soil fit for cultivation; while the culturable land would be improved by water resting on it and soaking in, instead of flowing over the surface and washing out the more valuable constituents of the soil. The material advantages thus secured would be still further increased by the sinking of wells, which could now be profitably made where they would have been wholly useless before.

5. A small area of poor land would thus be much improved and an increase of the cultivated area obtained, a portion of which could easily be watered from wells: when well irrigation might not be resorted to, the increased moisture of the soil would allow of cold weather crops being grown, where before precarious rain cultivation only was possible. The saturation of the sub-soil would form springs which would benefit land at a lower level.

6. Evidence of the beneficial result of this system is to be found in most of the valleys in the district, particularly in the Todgarh direction, where terrace after terrace of small fields may be passed for miles. The soil is held up by stone walls which are raised as the depth of silt accumulates; the fields thus formed are very productive and wells are numerous, and the value of land, as shown by the rates assessed on the cultivated area, is higher than elsewhere in the district. In the three tahsils the average rates given in the Settlement Report are as follows:—

	Rs	A.	P.	
Ajmere	1	6	4	per acre.
Beawar	1	10	3	do.
Todgarh	2	12	6	do.
Average of the district	1	10	6	do.

7. A similar system prevails, modified by local conditions, in the valleys in the Himalaya and in hilly districts in various other parts of the world. Where the nalas or streams become too large to be controlled by the small dams above recommended for this district, the water is of course allowed to flow down without any material interruption. In the Deccan, banks are very often formed on the lower sides of the fields to retain the water falling on them; it is sometimes done in the North-West Provinces, and doubtless also in many other parts of the country.

8. On visiting any of the localities in this district where this system of cultivation exists, it will be observed that trees grow much better than in the more open parts generally, doubtless because the soil is moister, is often of greater depth, and is enriched by organic matter washed off the hills, though the situation being in some respects sheltered may also favor the growth of the trees. From this it may be inferred that the systematic planting of trees or the conserving of the hill sides could most advantageously be carried out in connection with the plan above recommended for improving and increasing the soil. The forest operations and the interception of the drainage would mutually assist each other, the forests by increasing the moisture and the dams by retaining the water and improving the soil.

9. Were such a combined system adopted, the forests would in a year of scanty rainfall doubtless draw from the passing clouds many a light shower which would be of material service in such a year to the cultivation of the area protected; while the same clouds would pass over the more arid parts of the district without letting fall a drop of rain. If the combined system could be generally adopted over the whole of the suitable area in Ajmere-Merwara, it can scarcely be doubted that a considerable increase in the prosperity of the district would result, and its liability to suffer from periodical famine would be reduced. The partial introduction of the combined system would be a great boon to the localities which might be selected.

10. I have no hesitation in venturing the opinion that the money expended in a suitable locality on the small dams I here advocate would be far more beneficially laid out than the same amount spent on large storage reservoirs for irrigation, which will not ordinarily give a suitable return for the outlay on them. There is a place also for such reservoirs, but in a different locality. The small dams are more suited to the head of a drainage basin; while the large reservoirs can only be advantageously constructed at a considerable distance from the watershed, where the nalas are too large to be usefully blocked up by the small light dams.

11. In a year of drought, the supply of water in both systems would fail more or less; but where wells had been dug, it is most probable that those dependent on the small dams, particularly if in the neighbourhood of forest operations, would (from being far more numerous) protect a greater area of cultivation than the wells dependent on the large reservoir of equal cost with the small dams, even if the direct irrigation from the reservoir, which must be small in such a year, be included.

12. It would be very difficult to estimate the probable returns from a system of small dams as above proposed, owing to a want of data. The rates of assessment above quoted do not help much, as though the average rate in the Todgarh tahsil be double that in the Ajmere tahsil, this does not take account of the increased value caused by the introduction of wells, nor of the increase in the area of culturable land; these must probably be matters of conjecture merely. One great advantage is that the increased wealth would not result in a certain amount of demoralization of the people, as tank irrigation often in this district does.

13. Some measures would have to be devised to ensure the small dams being kept in repair independently of Government agency. The smaller tanks have their use, but not properly as irrigation works; for they do not hold water long enough to irrigate properly cold weather crops, which most need irrigation generally. The small tanks moisten the ground and allow of cold weather crops being grown in the bed without irrigation and supply water to wells.

14. As irrigation can only profitably be managed by Government from the large tanks, and large reservoirs cannot be constructed near a watershed, the land near the watershed must be neglected if large tanks only are to be constructed. If nothing be done for the land near the watershed, very little cultivation, and that of a very uncertain nature, can be carried on there and forest operations must be very slow.

15. By the proposed systematic construction of small dams on the lower slopes of the hills, the growth of the forests would be more rapid and cultivation would be improved. But the flow of water off the ground would be retarded, and the supply of the existing large reservoirs might be reduced. The dams would retard the surface flow, whatever increased flow the forests might give rise to; the net result would depend upon the proportion of the area intercepted by the dams. The reduction of the supply of the large reservoirs, however, I consider, looking at the general interests of the district, to be a less evil than the neglect of the higher lands. I do not recommend that the whole of such land should be cultivated with crops. I think it would be preferable generally to keep it for forest purposes when not detached.

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